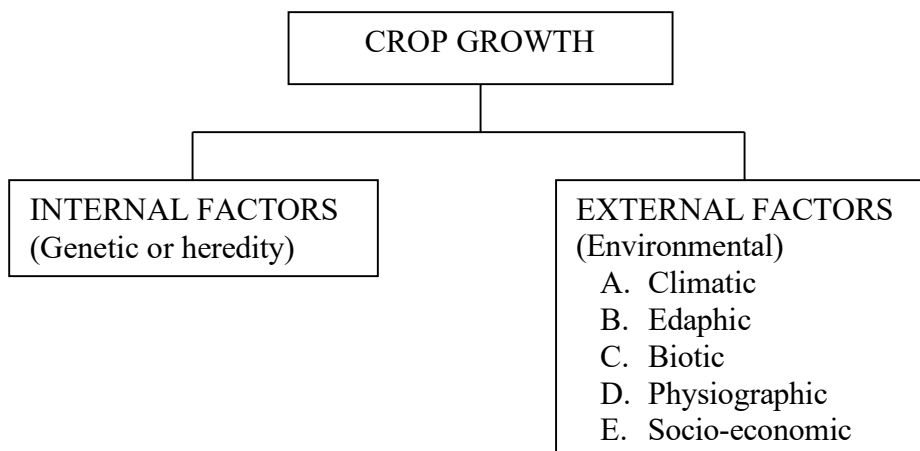


FACTORS AFFECTING CROP GROWTH AND PRODUCTION: GENETIC (INTERNAL) AND ENVIRONMENTAL (EXTERNAL) FACTORS

Genetic factors (internal) and environmental factors (external) are two major categories that influence the growth, development, and characteristics of living organisms, including plants. These factors play crucial roles in determining the traits of crops, their adaptability to specific conditions, and their overall performance.



1. Internal factors

Genetic factors

The increase in crop yields and other desirable characters are related to Genetic makeup of plants.

- High yielding ability
- Early maturity
- Resistance to lodging
- Drought flood and salinity tolerance
- Tolerance to insect pests and diseases
- Chemical composition of grains (oil content, protein content)

- Quality of grains (fineness, coarseness)
- Quality of straw (sweetness, juiciness)

The above characters are less influenced by environmental factors since they are governed by genetic make-up of crop.

2. External factors

- A. Climatic
- B. Edaphic
- C. Biotic
- D. Physiographic
- E. Socio-economic

A. CLIMATIC FACTORS

Nearly 50 % of yield is attributed to the influence of climatic factors. The following are the atmospheric weather variables which influences the crop production.

1. Precipitation
2. Temperature
3. Atmospheric humidity
4. Solar radiation
5. Wind velocity
6. Atmospheric gases

Precipitation

- Precipitation includes all water which falls from atmosphere such as rainfall, snow, hail, fog and dew.
- Rainfall one of the most important factor influences the vegetation of a place.
- Total precipitation in amount and distribution greatly affects the choice of a cultivated species in a place.
- In heavy and evenly distributed rainfall areas, crops like rice in plains and tea, coffee and rubber in Western Ghats are grown.

- Low and uneven distribution of rainfall is common in dryland farming where drought resistance crops like pearl millet, sorghum and minor millets are grown.
- In desert areas grasses and shrubs are common where hot desert climate exists
- Though the rainfall has major influence on yield of crops, yields are not always directly proportional to the amount of Precipitation as excess above optimum reduces the yields.
- Distribution of rainfall is more important than total rainfall to have longer growing period especially in drylands.

Temperature

- Temperature is a measure of intensity of heat energy. The range of temperature for maximum growth of most of the agricultural plants is between 15 and 40°C.
- The temperature of a place is largely determined by its distance from the equator (latitude) and altitude.
- It influences distribution of crop plants and vegetation.
- Germination, growth and development of crops are highly influenced by temperature.
- Affects leaf production, expansion and flowering.
- Physical and chemical processes within the plants are governed by air temperature.
- Diffusion rates of gases and liquids changes with temperature.
- Solubility of different substances in plant is dependent on temperature.
- The minimum, maximum (above which crop growth ceases) and optimum temperature of individual's plant is called as cardinal temperature.

Crops	Minimum temperature °C	Optimum temperature °C	Maximum temperature °C
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Rice	10	32	36-38
wheat	4.5	20	30-32
Maize	8-10	20	40-43
Sorghum	12-13	25	40
Tobacco	12-14	29	35

Atmospheric Humidity (Relative Humidity - RH)

- Water is present in the atmosphere in the form of invisible water vapour, normally known as humidity. Relative humidity is ratio between the amount of moisture present in the air to the saturation capacity of the air at a particular temperature.
- If relative humidity is 100% it means that the entire space is filled with water and there is no soil evaporation and plant transpiration.
- Relative humidity influences the water requirement of crops
- Relative humidity of 40-60% is suitable for most of the crop plants.
- Very few crops can perform well when relative humidity is 80% and above.
- When relative humidity is high there is chance for the outbreak of pest and disease.

Solar radiation (without which life will not exist)

- From germination to harvest and even post harvest crops are affected by solar radiation.
- Biomass production by photosynthetic processes requires light.
- All physical process taking place in the soil, plant and environment are dependent on light
- Solar radiation controls distribution of temperature and there by distribution of crops in a region.

- Visible radiation is very important in photosynthetic mechanism of plants. Photosynthetically Active Radiation (PAR - 0.4 – 0.7 μ) is essential for production of carbohydrates and ultimately biomass.
 - 0.4 to 0.5 μ - Blue – violet – Active
 - 0.5 to 0.6 μ - Orange – red - Active
 - 0.5 to 0.6 μ - Green –yellow – low active
- Photoperiodism is a response of plant to day length
 - Short day – Day length is <12 hours (Rice, Sunflower and cotton), long day – Day length is > 12 hours (Barley, oat, carrot and cabbage), day neutral – There is no or less influence on day length (Tomato and maize).
- Phototropism — Response of plants to light direction. Eg. Sunflower
- Photosensitive – Season bound varieties depends on quantity of light received

Wind velocity

- The basic function of wind is to carry moisture (precipitation) and heat.
- The moving wind not only supplies moisture and heat, also supplies fresh CO₂ for the photosynthesis.
- Wind movement for 4 – 6 km/hour is suitable for more crops.
- When wind speed is enormous then there is mechanical damage of the crops (i.e.) it removes leaves and twigs and damages crops like banana, sugarcane
- Wind dispersal of pollen and seeds is natural and necessary for certain crops.
- Causes soil erosion.
- Helps in cleaning produce to farmers.
- Increases evaporation.
- Spread of pest and diseases.

Atmospheric gases on plant growth

- CO₂ – 0.03%, O₂ - 20.95%, N₂ - 78.09%, Argon - 0.93%, Others - 0.02%.

- CO₂ is important for Photosynthesis, CO₂ taken by the plants by diffusion process from leaves through stomata
- CO₂ is returned to atmosphere during decomposition of organic materials, all farm wastes and by respiration
- O₂ is important for respiration of both plants and animals while it is released by plants during Photosynthesis
- Nitrogen is one of the important major plant nutrient, Atmospheric N is fixed in the soil by lightning, rainfall and N fixing microbes in pulses crops and available to plants
- Certain gases like SO₂, CO, CH₄, HF released to atmosphere are toxic to plants

B. EDAPHIC FACTORS (soil)

Plants grown in land completely depend on soil on which they grow. The soil factors that affect crop growth are

1. Soil moisture
2. Soil air
3. Soil temperature
4. Soil mineral matter
5. Soil organic matter
6. Soil organisms
7. Soil reactions

Soil moisture

- Water is a principal constituent of growing plant which it extracts from soil.
- Water is essential for photosynthesis.
- The moisture range between field capacity and permanent wilting point is available to plants.
- Available moisture will be more in clay soil than sandy soil.
- Soil water helps in chemical and biological activities of soil including

mineralization.

- It influences the soil environment Eg. it moderates the soil temperature from extremes.
- Nutrient availability and mobility increases with increase in soil moisture content.

Soil air

- Aeration of soil is absolutely essential for the absorption of water by roots.
- Germination is inhibited in the absence of oxygen.
- O₂ is required for respiration of roots and micro organisms.
- Soil air is essential for nutrient availability of the soil by breaking down insoluble mineral to soluble salts.
- For proper decomposition of organic matter.
- Potato, tobacco, cotton linseed, tea and legumes need higher O₂ in soil air.
- Rice requires low level of O₂ and can tolerate water logged (absence of O₂) condition.

Soil temperature

- It affects the physical and chemical processes going on in the soil.
- It influences the rate of absorption of water and solutes (nutrients).
- It affects the germination of seeds and growth rate of underground portions of the crops like tapioca, sweet potato.
- Soil temperature controls the microbial activity and processes involved in the nutrient availability.
- Cold soils are not conducive for rapid growth of most of agricultural crops.

Soil mineral matter

- The mineral content of soil is derived from the weathering of rocks and minerals as particles of different sizes.
- These are the sources of plant nutrients eg; Ca, Mg, S, Mn, Fe, K etc

Soil Organic matter

- It supplies all the major, minor and micro nutrients to crops.
- It improves the texture of the soil.
- It increases the water holding capacity of the soil.
- It is a source of food for most microorganisms.
- Organic acids released during decomposition of organic matter enables mineralization process thus releasing unavailable plant nutrients.

Soil organisms:

- The raw organic matter in the soil is decomposed by different micro organisms which in turn releases the plant nutrients.
- Atmospheric nitrogen is fixed by microbes in the soil and is available to crop plants through symbiotic (*Rhizobium*) or non-symbiotic (*Azospirillum*) association.

Soil reaction (pH)

- Soil reaction is the pH (hydrogen ion concentration) of the soil.
- Soil pH affects crop growth and neutral soils with pH 7.0 are best for growth of most of the crops.
- Soils may be acidic (<7.0), neutral (=7.0), saline and alkaline (>7.0).
- Soils with low pH is injurious to plants due high toxicity of Fe and Al.
- Low pH also interferes with availability of other plant nutrients.

C. BIOTIC FACTORS

Beneficial and harmful effects caused by other biological organism (plants and animals) on the crop plants.

Plants

- Competitive and complimentary nature among field crops when grown together.
- Competition between plants occurs when there is demand for nutrients, moisture and sunlight particularly when they are in short supply or when plants are closely spaced.

- When different crops of cereals and legumes are grown together, mutual benefit results in higher yield (synergistic effect).
- Competition between weed and crop plants as parasites eg: *Striga* parasite weed on sugarcane crop.

Animals

- Soil fauna like protozoa, nematode, snails, and insects help in organic matter decomposition, while using organic matter for their living.
- Insects and nematodes cause damage to crop yield and considered as harmful organisms.
- Honey bees and wasps help in cross pollination and increases yield and considered as beneficial organisms.
- Burrowing earthworm facilitates aeration and drainage of the soil as ingestion of organic and mineral matter by earthworm results in constant mixing of these materials in the soils.
- Large animals cause damage to crop plants by grazing (cattle, goats etc).

Physiographic factors:

- Topography is the nature of surface earth (leveled or sloppy) is known as topography. Topographic factors affect the crop growth indirectly.
- Altitude – increase in altitude cause a decrease in temperature and increase in precipitation and wind velocity (hills and plains).
- Steepness of slope: it results in run off of rain water and loss of nutrient rich top soil.
- Exposure to light and wind: a mountain slope exposed to low intensity of light and strong dry winds may results in poor crop yields (coastal areas and interior pockets).

D. Socio-economic factors

- Society inclination to farming and members available for cultivation.

- Appropriate choice of crops by human beings to satisfy the food and fodder requirement of farm household.
- Breeding varieties by human invention for increased yield or pest & disease resistance.

The economic condition of the farmers greatly decides the input/resource mobilizing ability (marginal, small, medium and large farmers).