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Chapter 4 Factors affecting crop production

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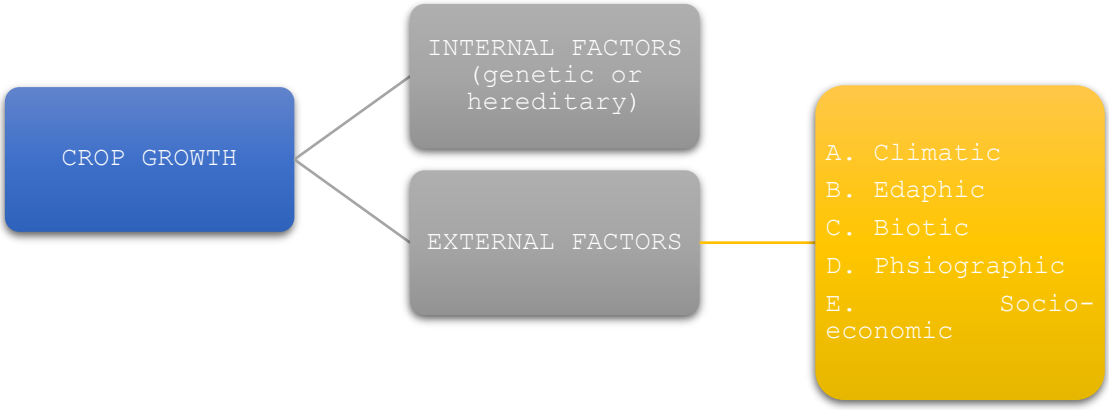
Chapter 4 Factors Affecting crop production



1.Internal factors/Genetic factors

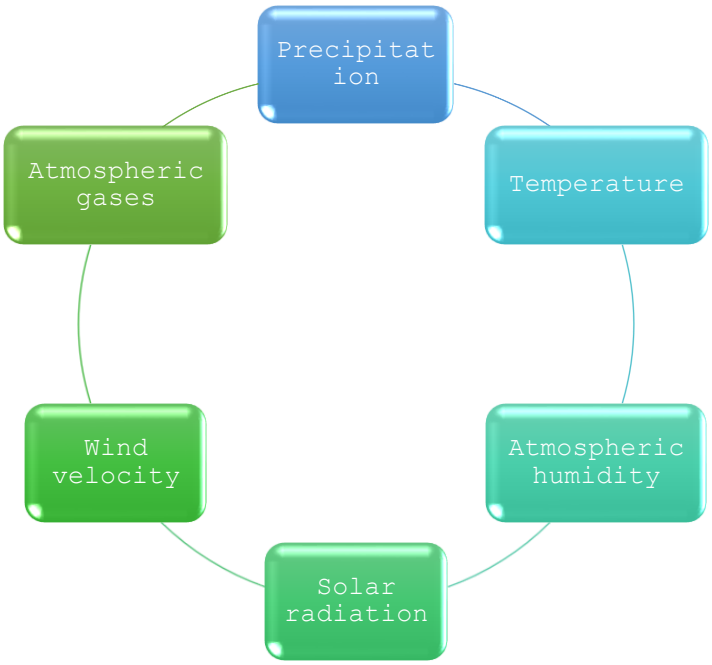
Certain characteristics in crops are attributed to Genetic make-up of plants and are not affected by environmental factors. For Eg :

- ✓ High yielding ability
- ✓ Early maturity
- ✓ Resistance to lodging
- ✓ Tolerance to Drought, flood and salinity
- ✓ Tolerance to insect , pests and diseases
- ✓ Chemical composition of grains (oil content, protein content)
- ✓ Quality of grains (fineness, coarseness)
- ✓ Quality of straw (sweetness, juiciness)

2.External factors

2.1 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.



Precipitation ;

- ✓ Total precipitation in amount and distribution greatly affects the choice of a cultivated species in a place. For eg :
  - In **heavy and evenly distributed rainfall areas**,: crops like rice in plains and tea, coffee and rubber in Western Ghats are grown.
  - In **areas of Low and uneven distribution of rainfall** : dryland farming is practiced and drought resistance crops like pearl millet, sorghum and minor millets are grown.
  - **In desert areas** : grasses and shrubs are common
- ✓ Distribution of rainfall is more important than total rainfall as excess rainfall may reduce the yield.

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.
- ✓ It also influences Germination, growth and development of crops.

- ✓ The minimum, maximum (above which crop growth ceases) and optimum temperature of individual's plant is called as **cardinal temperature**

Crops	Minimum temperature oC	Optimum temperature oC	Maximum temperature oC
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)

- ✓ **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 of 40-60%** is sutable for most of the crop plants.
- ✓ 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.
- ✓ 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.
- ✓ **Photosynthetically Active Radiation (PAR - 0.4 – 0.7µ):** It is light of wavelengths 400-700 nm, the portion of the light spectrum **utilized by plants for photosynthesis** and is **essential for production of carbohydrates and ultimately biomass.**
- ✓ **Photoperiodism**: Response of a plant to day length. It is the biological response to a change in the proportion of light and dark in a 24-hour daily cycle
    - On the basis of photoperiodism plants can be classified into
        - Short Day plant
        - Long Day plant
        - Day Neutral

Short day – Day length is < 12 hours (Rice, Sunflower and cotton)

Day neutral – There is no or less influence of day length (Tomato and maize

Long day – Day length is > 12 hours (Barley, oat, carrot and cabbage)

- ✓ **Phototropism** — Response of plants to light direction. Eg. Sunflower
- ✓ **Photosensitive** – Plants are very sensitive to light conditions, in part due to a signal that activates special photoreceptors. These light signals control plant growth and development by activating or inhibiting **plant hormones**. Season bound varieties depends on quantity of light received,

Wind velocity

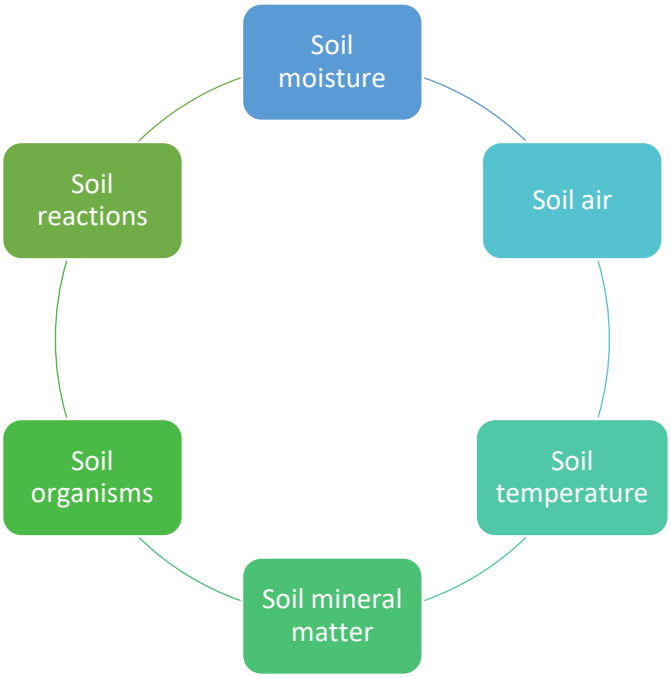
- ✓ The basic function of wind is to carry moisture (precipitation) and heat. It also supplies fresh CO2 for the photosynthesis.
- ✓ Wind movement **for 4 – 6 km/hour** is suitable for most crops.
- ✓ It could also damage the crops if speed is more. It removes leaves and twigs and damages crops like banana, sugarcane.
- ✓ **Wind dispersal of pollen and seeds** is natural and necessary for certain crops.
- ✓ Causes soil erosion and spreads pests and diseases.

Atmospheric gases

- ✓ **N2 - 78.09%, O2 - 20.95%, Argon - 0.93%, CO2 – 0.03% ,Others - 0.02%**
- ✓ **CO_2 is important for Photosynthesis**, CO_2 taken by the plants by diffusion process from leaves through stomata
- ✓ CO_2 is returned to atmosphere during decomposition of organic materials, farm wastes and by respiration
- ✓ **O_2 is important for respiration of both plants and animals** while it is released by plants during Photosynthesis
- ✓ Atmospheric N is fixed in the soil by lightning, rainfall and N fixing microbes.
- ✓ Certain gases like SO_2, CO, CH_4, HF released to atmosphere are toxic to plants

2.2 Edaphic factors (soil)

The soil factors that affect crop growth are:



Soil moisture

- ✓ Plants need water for **photosynthesis**.
- ✓ Absorbed by the roots, water travels through a plant's stems to the chloroplasts in the leaves.
- ✓ Water also **helps move nutrients from the soil into the plant**.
- ✓ The moisture range between field capacity and permanent wilting point is available to plants.
    - Too little water can cause a plant to wilt or droop. Too much water can cause a plant's roots to rot
- ✓ 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.

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

Note: *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 and **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
- ✓ 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 mineralisation process thus releasing unavailable plant nutrients

Soil organisms:

- ✓ The raw organic matter in the soil is decomposed by different microorganisms 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.

2.3 Biotic factors

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)

2.4 Physiographic factors

Topography is the nature of surface earth (leveled or sloppy). 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).

2.5 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).

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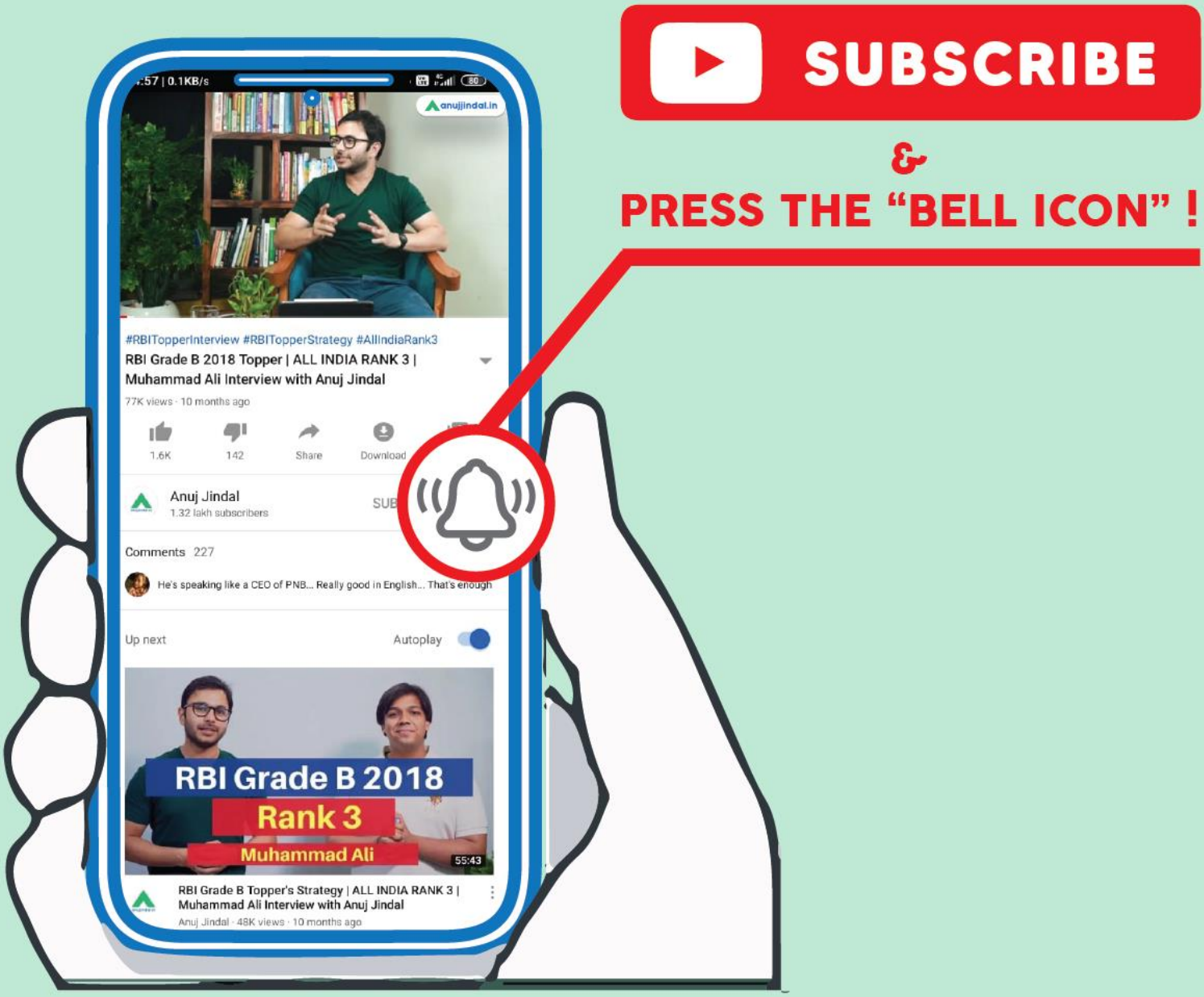
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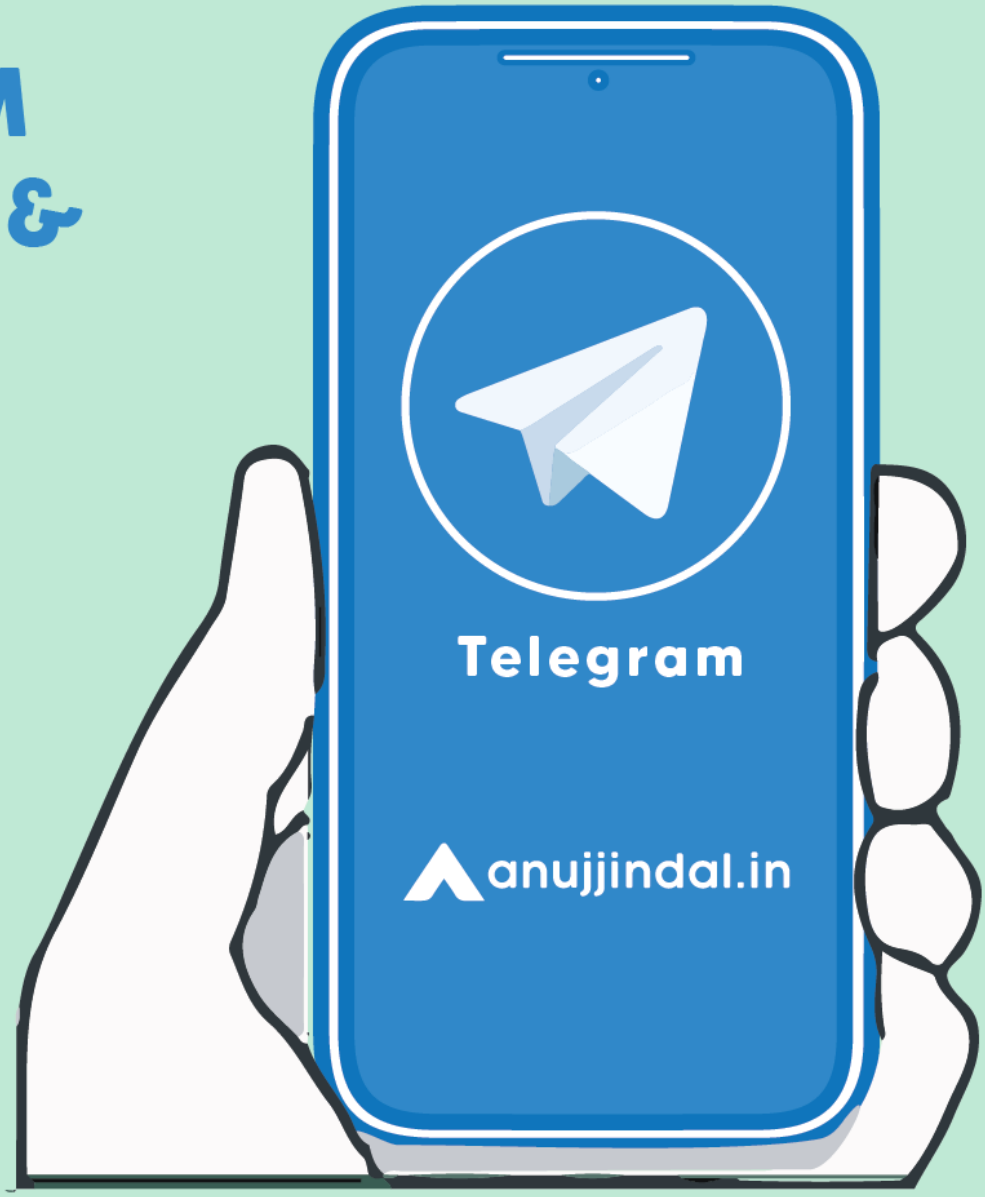

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