Factors limiting crops production and distribution

There is a close and strong relationship between cultivation (also known as domestication) and adaptation. In general, field crops must be placed in an environment that meets their 'requirements'. The future of agricultural productivity and sustainability depends on the ability of, field crops to grow and be productive in response to changing environments.

The term 'adaptation' refers to the ability of different species with different genetic (plant or animal) to live in a particular place or habitat. These adaptations might make it very difficult for the plant to survive in a different place.

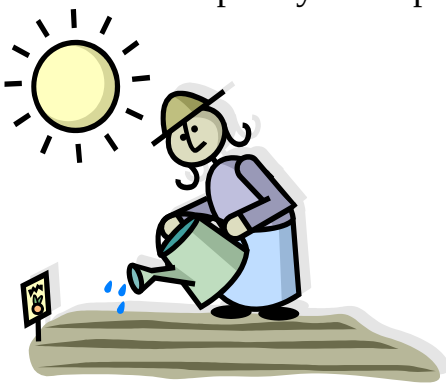
Environmental factors (ecology)

(A biotic factors) Climate and Weather

Climate includes temperature, precipitation, humidity, sky conditions, wind, and atmospheric pressure.

Climate is the average conditions over a long period.

Weather is the current and temporary atmospheric conditions difference is time span



Climate Types

- Macroclimate describes the conditions over a relatively large area i.e. a portion of a state or country
- Local climate refers to more localized conditions i.e. a valley or mountain
- Microclimate is the conditions around a plant or leaf, Microclimate can be modified by us to grow marginally hardy plants

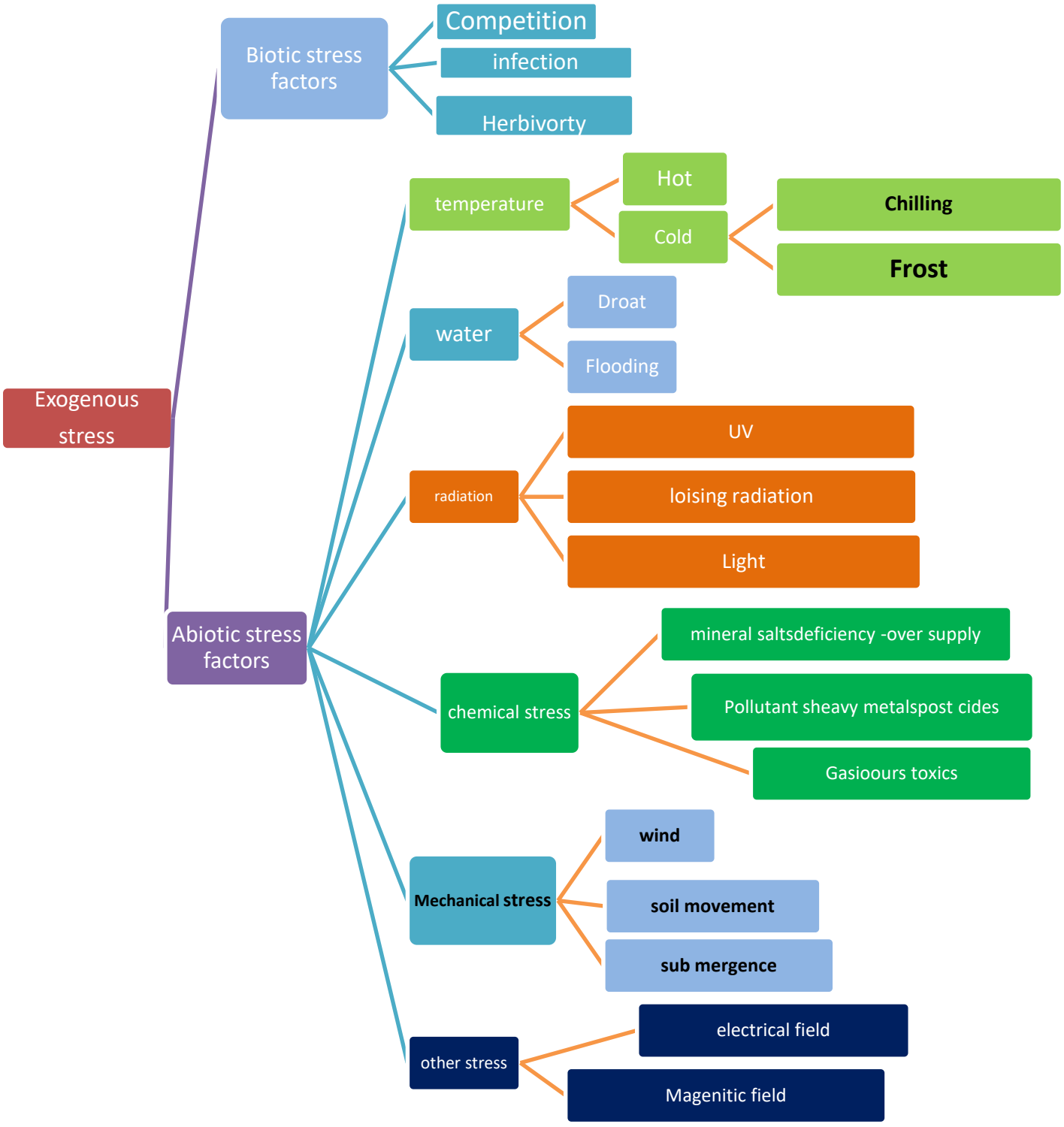


Fig. Biotic and abiotic environment factors which causes stress to plant

1 . Water and precipitation:

Precipitation includes rainfall, snow, hail برد fog ضباب, dew ندى etc

The water supply is one of the most important factors influencing crops production and distribution. Another sources of water is humidity which is water vapor in the air.

Relative humidity is the vapor pressure in the air in terms of percentage necessary to saturate the atmosphere at the particular temperature.

The crops regions according to annual rainfall are:

1. Arid region with less than 10 inches of annual rainfall (250 mm).
2. Semiarid region 10-19 inches (250-500 mm).
3. Sub humid region 20-39 inches (500-750 mm).
4. Humid region 40-59 inches (750- 1000 mm) 5. Wet region 60 inches or more (more than 1000 mm)

Plants types according to water tolerance:

- **Hydrophytes:**

Include those need water such as lowland types of rice.

- **Mesophytes:**

Most of field crops are Mesophytes.

- **Xerophytes:**

Some crops are highly resistant to drought conditions such as dwarf green sorghums.

Most plants are sensitive to flooding and logging (especially in small cereals) which is one of the main agronomic problems (why)?

All pores are filled with water; so the oxygen supply is almost completely deprived (water logging) and plant roots cannot obtain oxygen for respiration to maintain their activities for nutrient and water uptake. Plants weakened by lack of oxygen are much more susceptible to diseases caused by soil-borne pathogens.

Moisture stress:

Occurs when a plant is unable to absorb a depute water to replace that lost by transpiration Plant losses water by evaporation or transpiration or the combination of the two processes (evapotranspiration).

Factors which influence the water requirement of plants

1-Adaptive plant characters: Some morphological plant characters which are making it possible to adapt drought:

- Smaller leave area.
- Increase root system volume.
- Thickness of cutinized epidermal cell.
- Decrease amount of transportation with increasing its speed.
- Decreasing in photosynthesis speed or decrease in CO2 absorption
- Increasing of sugar in cells.
- Decreasing of inter cellular.
- Decreasing the shoot root ratio.

2- **Effect of fertility on water requirement:**

3-Effect of the amount of soil moisture on water requirement.

4- **Water requirement of different plants:**

Some plants require more water because of a larger total production of dry matter and therefore of water required per acre.

5- **Effect of cropping on water requirement**:

Swage water *is the water unfit for use (Why)*?

Because it may be including heavy metals, pesticides which soon enter into the food chain and harm animals finally man, DDT is feared to cause cancer.

Temperature

Facts on temperature:

Each crop has its own minimum, maximum and optimum temperature values for normal development and survival. Temperature influenced differently with the basic physical factors such as terrain (altitude and climate). Maize matures in 3–4 months and the climate is too hot for potatoes; however, about 50 km away in the highlands (above 1500 m), maize takes 5–10 months to mature and potatoes thrive (grow successful).

Advantage (benefit):

- Temperature is an important factor in limiting the growing of certain crops during their life, and during the stages of life (germination, seedling, vegetative growth, or reproductive growth and ripening stages).
- Temperature regulates all the chemical and physiological processes of plant metabolism.

- Temperature also affects soil organisms nitrifying bacteria inhibited by low temperature, also pH decrease in summer due to activities of microorganisms
- Soil temperature has direct dramatic effects on microbial growth and development, organic matter decay, seed germination, root development, and water and nutrient absorption by roots. In general, the higher the temperature, the faster these processes occur. The size, quality and shape of storage organs are greatly affected by soil temperature.
- Excessively high daytime temperatures can adversely affect growth, yields a crop's length of growing period as Well as its adaptation to the area. By causing pollen sterility and blossom drop (by elevation in every 100 m).

Optimum root and shoot temperature of various crops

Crops	Roots(◦c)	Shoots(◦c)
Alfalfa	20- 28	20-30
Barley	13-16	15-20
Corn	25-30	25-30
Cotton	28-30	28-30
Oats	15-20	15-25
Rice	26-29	26-29
Wheat	18-20	18-22

Vernalization:

It means the promoting هاندانof flowering of some cereals by cold treatment of the moistened of germinating seeds. Many plants require exposure low temperature to induce رودانflowering, such as winter types of wheat. Initiate flower formation after extended (4–8 weeks or 2–3 months) exposure to low temperature 1-5 °c. The required length of low temperature exposure varies with species

Notes :

1- Slope, the slope of 0 - 2.5º is the fittest for cultivation .Slops that face south and west receive the most sunshine and regularly warmer than slops facing north and east.

2- Most crop plants make their best development between (16-32ºc) they either cease راکرتن growth or die when the temp becomes either too low or too high.

- Temp of (43- 54 ºc) will kill many plants.

Cool-season crops:

It means the crops that make their best growth under relatively cool conditions but are damaged by hot weather. e g: wheat ,oat ,barley ,rye ,potato ,flax , sugar beet, red clover , field pea and many grass.

Warm –season crops:

It means the crops that make their best growth under relatively warm conditions ,they appreciable size are killed by temp slightly below freezing and sometimes at several degree above freezing when exposed يبينfor prolonged period .

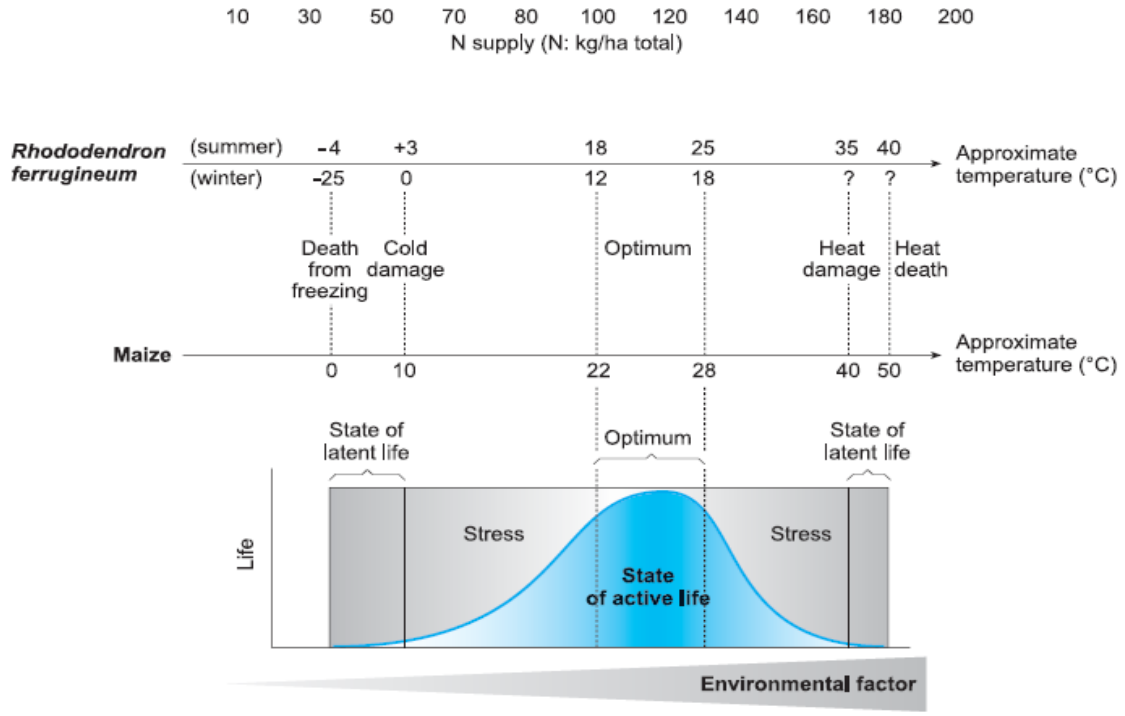


Fig. 1.1.3. Life processes of an organism described as a function of an (abiotic) environmental factor. The **relative growth rate**, **R**, may be used as a measure of life processes:

$$R = \frac{\Delta \text{biomass}}{\Delta t} \times \frac{1}{\text{biomass}}$$

Note :

Chilling injury: Is caused when temp goes below the minimum; most crops (tropical or subtropical plants) are injured at temperatures slightly below freezing or 10 °c.

Desiccation (الجفاف): Generally, is caused when the temp goes above the maximum. When temperatures rise, Occurs in the range of 45-55°c, because of the heat destruction of the protoplast (called coagulation), cells die.

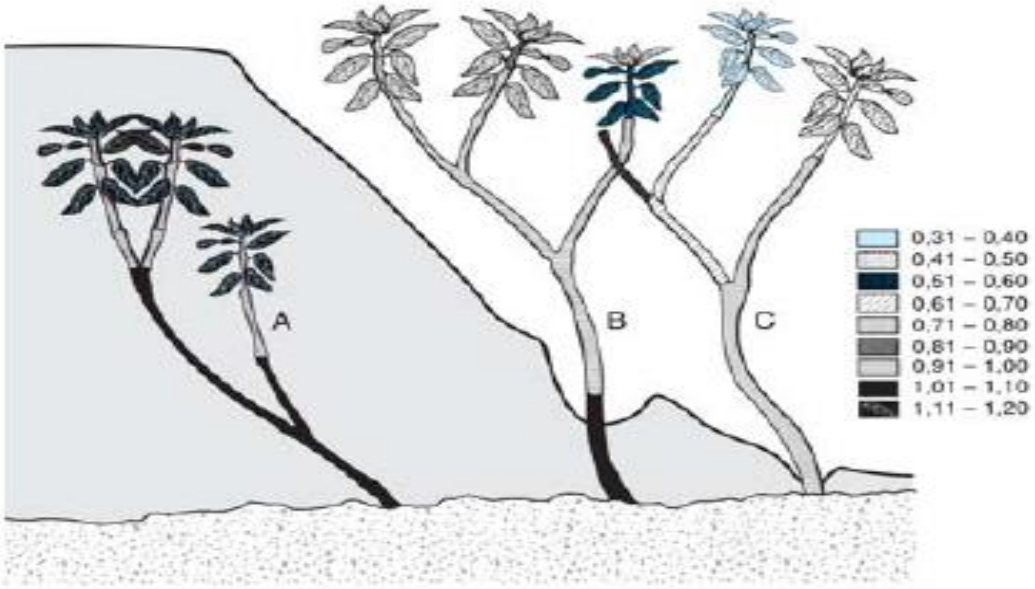


Fig. 1.3.33. Frost drought. Water contents (in g H_2O/g dry wt.) in leaves and shoots of the Alpine rose (*Rhododendron ferrugineum*) in winter. A Continually covered with snow; B only the stem basis covered by snow; C on frozen ground without any snow cover during the entire winter (measurement in March). (After Larcher 2003)

Light:

Facts on light:

1- Light affects the plants in three ways, length, photo period, and duration.

2- Plant growth may increase with greater light intensities of 1.800 foot-candles (19.378 luxes)

3-Most plants need sufficient sunlight for vegetative growth, flower initiation and induction of dormancy.

2- According to amount of light which received it appears to be photomorphogenic minor or major structures such as internodes elongation, chlorophyll development, flowering, abscission, lateral bud outgrowth, and root and shoot growth).

Benefits of light:

1. Translated heat to earth and plants.

2. Light is necessary for the formation of chlorophyll in green plants, for photosynthesis so asparagus and celery become white in the absence of light. and essential for the complete photoperiodic reaction.

3. it's important for photosynthesis.

4. It also regulates the opening and closing of stomata. Intensity, wave length.

5. It's important factors for flowering.

6. It is one of the factors influencing seed germination.
7. Support the growth of leaves, steam (Etiolating is abnormal elongation of steam caused (by insufficient light), flowering and fruiting and even the dormancy.
8. The accumulation of IAA under shaded or dark condition or sunlight destroys IAA. So the role of light is related to regulating the concentration of IAA.
9. Supports the consumption of accumulation CO_2 in air.

Crops are different in its requirement to light:

1- Corn, cucurbits, legumes, potato and sweet potato require a relatively high level of light for proper plant growth.

2- Onions, asparagus, carrot, celery, Cole crops, lettuce and spinach can grow satisfactorily with lower light intensity.

3- Among the reference crops, soya beans and the photosensitive varieties of millet and sorghum are the most affected, Maize is less influenced and this factor is usually not a critical factor for peanuts, beans and cowpeas.

The plants are divided according to **Phototropism** (The relative length of day and night or relative lengths of light and dark periods which influenced the live processes of many plants) into:

Phototropism: The developmental responses of plants to the relative lengths of light and dark periods.

1. Long day plants (short-night plants):

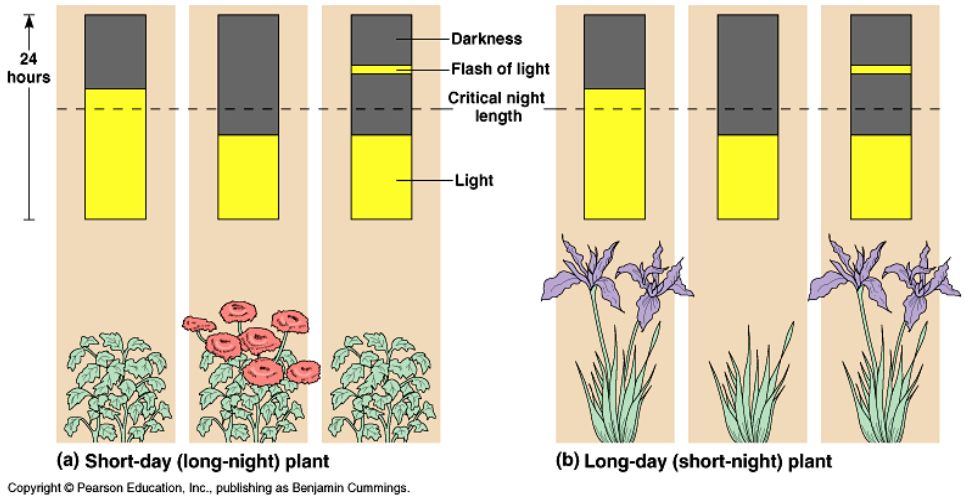
They are plants that flower only when light period are longer than a certain critical length. These plants flower mainly in summer and include annuals such as henbane which require more than 10 hours' light, spinach which require 13 hours.

(Or)It hasten flowering and maturity of these crops but reduced vegetative growth in the long day. or it require of inflorescences, but they increase in vegetative growth when the days are short, (require 14 hours' light and 10 hours' darkness).

Wheat, flax, barely, clovers, hibiscus. Most cool- weather crops have a long day response.

Short day plants **(long – night plants**):

These plants require day length less than a critical limit for flowering, stimulated to vegetative growth, with delayed flowering and maturity, when the days are long, and produce flower s and fruits when the days are relatively short. Corn, sorghum, rice, soybean. , strawberry when planted in the field short-day flower in early spring , (Require 10 hours light and 14 hours darkness).Most warm-weather crops have a short-day response.



3- Day –neutral plants:

These plants are not responsive to photoperiod and flower according to the development stage, nested, they may initiate flowering after attaining a certain overall developmental stage or age, or in response to alternative environmental stimuli, such as vernalisation (a period of low temperature) this include tomato, corn, cucumber.

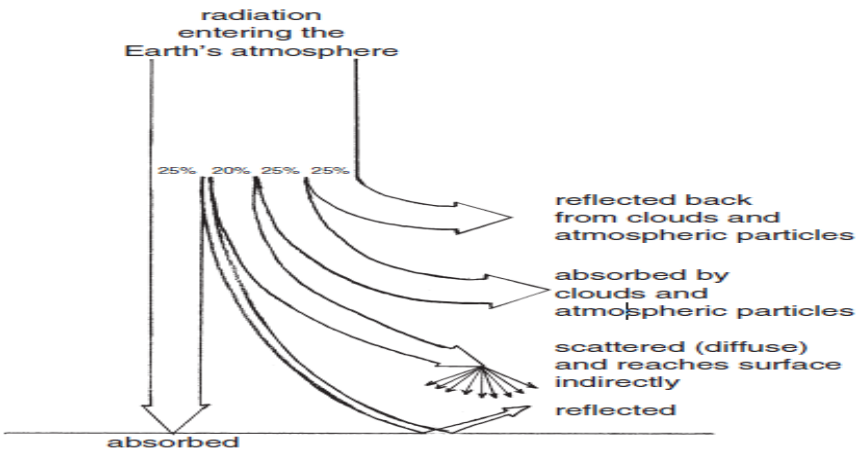
4. Intermediate plants:

Certain grasses such as Indian grass do not flower if the days are too short or too long, it has two critical photoperiods. Including faba bean, alfalfa, and peanut. When the exposure of light is10-14 hours' light or dark.

<u>Important notes</u> :

1. The length of the night (dark period) rather than the length of day is the critical determination.
2. Environmental factors such as temperature can modify the photoperiodic behavior of a plant for example: flowering in henbane is induced by exposure to 11.5 hours of light at 22.5 º c but it takes only 8.5 hours of exposure to light induced flowering at 15.5 º c.

2. The wavelengths that reach earth's outer atmosphere do not completely reach the surface-filtered.



Absorbed:

- Light absorbed by atmospheric components
  - Ozone
  - Water vapor (clouds)
  - Dust
  - Oxygen, Carbon dioxide.

UV (ultraviolet) and IR (infrared) light damaging to plants and absorbed in atm.

Reflection:

Clouds major reflector Ex. Flying on a cloudy day then breaking through the layer, the sunlight is ***very*** intense.

Scattered

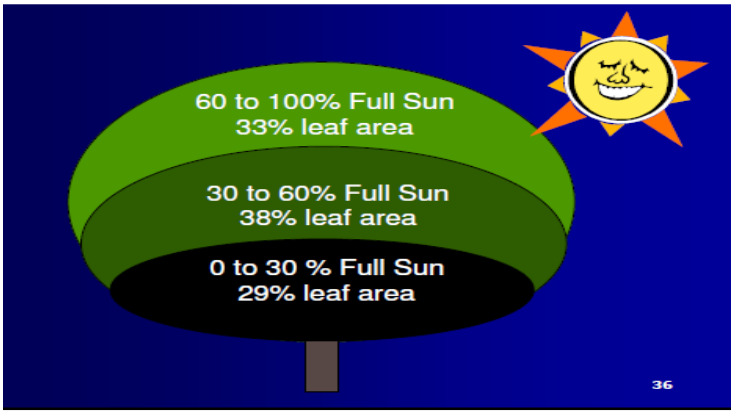
Dust, smoke, water droplets, smog

- Small particles (gas molecules) scatter يبعثرshorter wavelengths (blue)
  - Large particles (dust, smoke) scatter longer wavelengths (red)

Important Note :

Shading by a single leaf:

- Lowers light intensity to just 10% of leaves in full sunlight.
- Limits the export of carbohydrates to fruits.
- Reduced photosynthesis to 28% of leaves in the full sunlight.



Classification of plants according to its light requirement:

1. Helophytes:

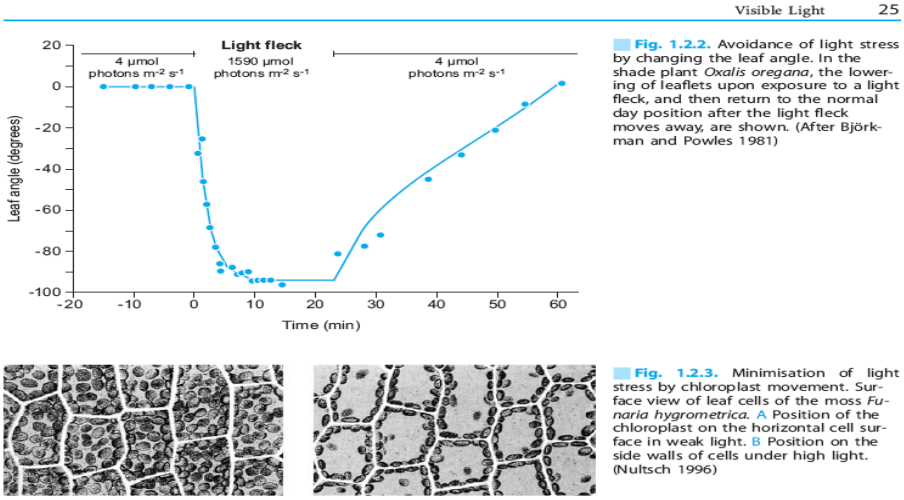
That group of plant continues its life cycle in an open land with plenty of light.

Specification:

a. Increase in vegetative growth and dry matter.
b. Increasing in root system.
c. Small internodes and smaller leaves and more thickness.
d. Decreasing in amount of stomata and decreasing in size.
e. Cutinized epidermal cell, and many other individuals.
f. All the field crops are helophytes

2. Sclophytes:

It requires low light and efficiency of photosynthesis is more in low light so we planted these types in green house, glasses house …etc. Some of horticulture plants are sclophytes.



Air

a. Supply carbon dioxide for plant growth.
b. Supply nitrogen indirectly.
c. Supply oxygen for respiration of the plant.
d. For the chemical and biological processes in the soil.
e. Air sometimes contains gaseous substances in concentration harmful to plant growth like ozone, PAN (proxy acetyl nitrate) usually come from fuel combustion or industrial furnes

What cause the excess of some gasses? (Disadvantage)

1. Ozone excesses causes spots on the leaves of tobacco, maize and other plants.
2. PAN causes young leaf tissue to collapse (يفقد).
3. Sulfur dioxide causes blotches between leaf veins.

4. Nitrogen dioxide suppresses plant growth.
5. Fluorides cause chlorotic patterns or the death of the margins and tips of the leaves.
6. Industrial smokes may effect on crop growth.

Advantage of air pollutants

1. All air pollutants including dust, soot and ashes, return to the earth eventually in rain, snow or by gravity or downward air currents.
2. Ashes and dust content essential plants nutrients such as K, P, Ca.
3. Some atmospheric nitrogen is released by soil organisms that use the O_2 in nitrogen oxides during anaerobic conditions.
4. CO_2 absorbed directly by plants in photosynthesis and some of CO converted to CO_2 or carbonates by lightning or solar energy in the air .
5. P and its compounds from air, sewage when emptied into still waters promote the growth of algae.

Wind

Wind velocity depends upon various factors such as geographical situation, topography, altitude, and distance from seashore, floatplanes, and vegetation.

Advantage and disadvantage of wind:

1. Wind may cause mechanical laceration (تمزيق) and bruises (يخدش اويجرح) to the tissue of crop plants Or uprooting
2. High wind may bruise and tear the leaves
3. Often happens with small grain grown on fertile soils.
4. The plants may be blown over or lodged.
5. The rate of transpiration or water loess from plants.
6. Increase in proportion to the square root of the wind velocity.
7. Crop plants may be cut off by moving sand particles.

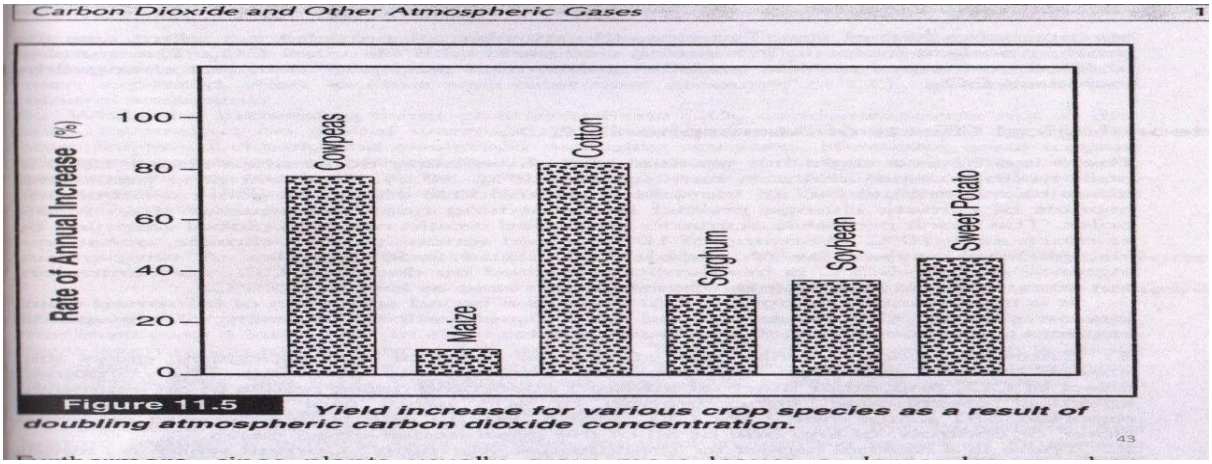


Figure 11.5 Yield increase for various crop species as a result of doubling atmospheric carbon dioxide concentration.