

Environment primary
factor that influences
plant growth
development biology
essay...



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Although there is no doubt that the world population grows up in more gradual way every year, demanding more food than any other time before, Environment is the primary factor that influences the plant growth and development and has also the greatest effect on the crop distribution on the earth. In this ten page report, the most important environmental factors that affect the crop growth and development namely light, water, temperature and carbon dioxide are covered, emphasizing their influences on crop productivity.

Moreover light as the most environmental factor importance on crop production and productivity, all light quality, quantity and duration effect directly on crop yields, also in most cases plant reactions and processes are greatly influences by the temperature, plants key process affected by temperature is photosynthesis followed by germination, transpiration, respiration and flowering. However, crop temperature requirements in a specific physical, chemical or biochemical process varies from one spice to another resulting difference among crops in their geographical distribution.

On the other hand, water and humidity play an important role for the crop productivity since most plants need 90% water content to grow effective and efficiency way until some crops like rice demand flooding the area to grow properly. In addition to the plant water needs, plants are number one consumers of carbon dioxide on the earth so as to synthesize food and energy. Each of these factors were discussed in this report emphasizing and giving more detailed look on their effect on crop productivity.

Light

Why solar energy is important to a successful plant growth, development and improvements to its yields? On the planet life is mostly solar-powered, sun is the only natural source of light energy, all the living organisms depend on the amount of light energy (solar radiation produced by the sun) harvested by green plants at any level of ecosystem, only few types of bacteria can derive the energy they require from sulfur and other inorganic chemical compounds or substances. Photosynthesis which is the process that the plants manufacture their food molecules from carbon dioxide and water by using the sun light, therefore the rate of duration of photosynthetic activities directly effects the amount of dry matter produced by the plant, and energy harvested as crop yields to transfer energy from primary producers to the other components of the ecosystem which are the consumers, so the ultimate source of food in the globe is the green plant, because plants have the ability to harvest and utilize the sun light manufacturing a usable food after three main consecutive processes during plant's photosynthetic activities.

Photosynthesis

The management of that resources available to the production, that the crop requires to grow and develop and show its potential genetic characteristics as much as possible is a major factor that contribute the dramatic rise of the crop production, only organisms/plants that contain a certain pigment called chlorophyll which is the most abundant enzyme/protein on the earth are capable to utilize solar energy directly. It is therefore; light is an important factor to produce energy by the plants and the energy produced will be supplied to the different levels of the ecosystem. The light influence on the <https://assignbuster.com/environment-primary-factor-that-influences-plant-growth-development-biology-essay/>

plant development and productivity can be discussed into three main categories.

Quality of light

The intensity of light and its concentration are what decide the quality of light; light densities differ from one season to another, countries that have three or four seasons, the largest amount of light is found in the summer season, where the least amounts are available in the winter, as the case is in many European countries, but areas like Malaysia the amount of light available throughout the year is almost the same, so the light intensity varieties depend on the geographical area, for example in Sub-Saharan Africa where the climate is desert, clouds and other sun light barriers are not found in the atmosphere, the sunlight density is very high. Not straying from the main point, the more light radiation that a plant harvests, the greater and the ore ability to manufacture food through photosynthetic processes even though this relationship will depend on the pathway group that a certain plan flows.

From this interactions, the scientists specially those botanists, ecologists and physiologists realized the direct relationship the amount of light available to the plant and the crop productivity, that is why the greenhouse managers to fix artificial light sources to supply light their fields to create longer photoperiod in the greenhouse targeting more improvements to the final output, even though this strategy will negatively affect the cost of every unit produced under this system. However, they can easily manipulate the amount of light of the planned growth patterns to their plants.

Quality of light

Are there different light qualities? Light colors, which can be divided into bands of red, yellow, blue, orange, violet and indigo. The red and blue color lights that the plant can absorb have the biggest influence on crop growth, the blue light is primarily responsible to the leaf vegetative growth and the combination of red and blue lights encourage the flowering process.

The solar rays produced by the sun, or what is normally known as wavelength of the light constitute the light quality, wavelengths that the sun sends to the earth ranges 250 - 7000 nanometers, these solar rays reaching the earth are divided into eight parts, only the visible radiation is called light, and the other which are Cosmic rays, Gamma rays, X-rays, Ultraviolet, Infrared, Microwaves and Radio waves are invisible. The visible solar rays or light is the small proportion of the range of wavelengths of the electromagnetic radiation occurring somewhere between 400 and 735 nanometers. In other words the visible light is between Ultraviolet which are shorter waves than 390 nanometers and Infrared which are longer waves than 700 nanometers. Only 47% of the light produces by the sun is gained by the earth (P. Bannister 1978), where the other 53% part of it is absorbed by the atmosphere while other part is reflected by some barriers and finally gained by the space. Only 2% of that 47% of the light that reaches the ground is used in the photosynthetic processes and about 10% is used different processes that occur in the plant.

Duration of light

Photoperiod or the duration of light is referred to how long of time the plant exposes to light, the flowering of many plant species is controlled by the photo duration, as a result that, the plant physiology experts tend to name and classify plants into short-day and long-day plants relating to under which condition do these crops flower. In contrast, the duration of uninterrupted darkness which presents a critical situation to the crop development and flowering process is the factor that show the importance of light duration not only the plants but also on farm animals specially poultry production therefore shorter darkness periods are encouraged.

The amount of carbon dioxide fixed and assimilated by a specific plant is determined by the light density, because several situations can be seen when the plant is grown the area where the light intensity is not constant this is much explained in the plant's light response curve, which shows light compensation point, plant light response area and plant's light saturated period where any further increases of the light available to the plant will not result an increase in the amount of the carbon dioxide absorbed from the atmosphere, meaning photosynthetic activities will peak t that point and all the enzymes involved to this process are active. From this concept, the ecologists realized some remarkable differences among the two main pant pathway groups C3 plants, C4plants. Because the carbon dioxide concentration is not the same in these pathways as soon as there are variations in amounts of light available (lower, neutral and higher) the different light amounts are available to the crop, the growth, development and productivity are highly effected by the light factor. In addition to that, C4 plants showed higher net rate of photosynthesis as a result of light intensity

increases than C3 plants. Even though at a very low light intensities C3 plants are more affective and efficiency than C4 plants because of their low compensation points, crops like corn and sorghum full sunlight for photosynthesis while tobacco can tolerate only partial sunlight.

Water

Water is the most component in the living cell, plants contain nearly 90% of water content , this high percentage enables us to understand the remarkable role of water on the crop growth and development, large quantities of agricultural output all over the world is heavily depend on different types of irrigation, over 1500 million hectares of agricultural land are irrigated every year, the continuously rise of the global temperature is seem to be the highest impact on the irrigated agriculture when considering water (hydrological) cycle.

Water in a primary component in plant photosynthesis, the plant respiration, responsible to balance the pressure (turgor) in the plant cell, turgor is required to form the cell shape, tissue firmness and fullness, and ensure cell development. Also water is the place and the solvent where carbohydrates and minerals are transported from the soil and/or leaves to the other parts of the plant. Water treats as a cooling system to regulate the plant temperature specially on the leaf surface through a process called transpiration, water controls the stomata opening and closure, water provides a kind of power to encourage roots to penetrate the soil more in depth and this will enlarge the space that the crop can absorb the nutrients needed for growth and development. One more crucial role is that the water is the medium where

biological reactions take place, also water is a component in the organic reactions, and it is used in the cell growth. Amount of water available in the plant compared the atmosphere water content (atmosphere humidity) is the limiting factor of crop photosynthesis, the ratio of the amount of water vapor available in the air to the volume of water that the air can keep at specific temperature and pressure is called relative humidity. Water vapor is the whenever a water molecule leaves from the surface of the ground, it is said to have evaporated. Each individual water molecule which transitions between a more associated (liquid) and a less associated (vapor/gas) state does so through the absorption or release of kinetic energy. On the other hand, In the hot climate, wind and dry air conditions while there is a moisture stress or what scientifically called water deficit caused by the low water content, in this situation the stomata aperture is dramatically reduced and the photosynthetic reactions are weakened because the activeness and the effectiveness of the enzymes have a direct proportional relationship to the amount of water found from the surrounding environment and inside the plant tissue and indirectly proportional to the temperature specially the extreme one.

Temperature

As said in the beginning temperature is important factor to the plant growth, development and yield, since it affects approximately most of the plant processes including germination, photosynthesis, respiration, transpiration and flowering. As the degree of temperature increases this will result an increase to the plant respiration and photosynthesis. Generally in temperate species, the increase in temperature about 10oC (18oF) will cause to the rate <https://assignbuster.com/environment-primary-factor-that-influences-plant-growth-development-biology-essay/>

of carbon dioxide (CO₂) assimilation approximately to double. Furthermore usually plants in the tropical areas require higher temperature degrees to perform successful photosynthetic processes to the possible maximum level that the plants in the temperate areas can generate.

Usually, plants differ their temperature requirements for example radish, spinach and lettuce which are cold weather (season) crops germinate at 55oF - 65oF best, where crops like petunia, lobelia and tomato which are hot climate crops germinate at about 65oF - 75oF best. According to the level of the temperature, plant processes can speed up or slow down the period that each activity completes. For instance, the 18 months that the oil palm plants need to live in the nursery can be reduced to about 10 months when provided higher temperatures from artificial sources.

Flowering however, experts in horticulture sometimes relate the length of the day to the temperature to manipulate flowering. For example the combination of short days with low temperature degrees helps cold-season plants to set the flowers as the case in Christmas cactus, when the temperature levels are in their highest points and the days are in their longest hours the summer (cold-season) crops will bolt as in the case in spinach. In contrast, when the temperature is extremely cold, plants like tomato which is warm climate crops will set their fruits in unsuccessful manner.

Temperature influence on biochemical plant processes

Biochemical reactions of the plant are directly affected by the temperature through one or two principle functions, an exponentially dynamic increase to <https://assignbuster.com/environment-primary-factor-that-influences-plant-growth-development-biology-essay/>

the rates of proceeding activities. And sometimes as the climate gets hotter more exponential delay will be experienced resulted by enzymes lost their naturalness. The most important and involved factor is the weather, it is not impossible to rise the quality of enzyme stability so as to avoid losses in their naturalness.

The everyday changes on the temperature is called thermo-period the best crop growth occurs when the difference between the day and night temperatures is about 10 to 15o C. under this situation plant build up their food and break down the energy, higher temperatures than that required by the crops cause some crops to photo-respire and the amount of food manufactured by the photosynthesis will equalize the energy used to at that time and carbon dioxide CO₂ assimilated will be zero meaning that the crop is in the state of light compensation point. Therefore food molecules synthesized from the photosynthetic activities must overweight the energy that the plant consumes otherwise the plant will grow poorly resulting drops in the ultimate yields.

Higher temperatures and their long-term influences on the crop

The chronic effects meet the crop growth and development when the temperature is getting higher every day the crop stress will become more serious because of the extreme hot weather. However C₄ plants showed a higher net rate of photosynthesis than C₃ plants when temperature levels at the surface of leaves were increased.

In 1993 Kropff and his colloquies, found that 9% decrease of rice productivity were recorded for every 1o C increase of the temperature, the <https://assignbuster.com/environment-primary-factor-that-influences-plant-growth-development-biology-essay/>

Intergovernmental Panel on Climate Change (IPCC) coordinating with the Food and Agricultural Organization of the United Nations (FAO), their second evaluation report in December 1995 forecasted that the temperature of the planet will rise about 2 - 5°C during 21st century and the sea level will grow up about 30 to 100 cm more, and this higher sea levels can submerge many agricultural areas in the world, these weather conditions will negatively affect the food production in the globe.

Carbon dioxide

When crops are manufacturing their food through photosynthesis, carbon dioxide is the most component factor importance in that process, plants obtain CO₂ from the air through the pore spaces on the surface of the leaf when open, CO₂ flow in the plant tissue depends on the carbon dioxide concentration inside the plant and the plant's surrounding atmosphere, the carbon dioxide molecules (substances) move inside the plant when the concentration inside is less density than its concentration outside and this is a physical process called diffusion.

The carbon dioxide flow in the plant is controlled by the stomata then the pore spaces on the leaf surface are open, and the aperture of the stomata its turn depends on the amount of water available in the guard cells.

Overview of carbon dioxide influence on plant growth and development

Plants are divided into two main categories according to their response and their first stable product after the fixation of carbon dioxide. The first category is those species whose first stable products after the fixation of

carbon dioxide is three carbon molecules and the plants under this group are called C3 plants or C3 pathway. The second group is the species that their first stable products after the fixation of carbon dioxide are four carbon molecules and plants in this group are called C4 plants or C4 pathway, also there are CAM plants, these plants have different character, because the plant here operate fixing carbon dioxide in dark, plants depend on the amount of carbon dioxide accumulated in the leaf in the night.

The photosynthetic rates of the plant directly relate to the growing amounts of carbon dioxide until it reaches approximately 700 μ mol/mol or higher according to the plant type and other factors. Furthermore photosynthesis always develops with the rise of temperature to optimum levels and after specific maximum level the photosynthesis in C3 plants show decline, as a result of photorespiration process which takes place in the plant.

As some scenarios of the world climate change mentions, a global warming is forecasted and that will increase the amount of carbon dioxide available in the atmosphere as well as other gases in the green house. Mean while the amount of rain in many places of the world may also experience changes, generally scientists believe that certain plant species will indicate yield increase especially in C3 plants (C3 pathway includes many important crops like wheat, rice, oats, soybean, pea, peanuts, sunflower and tomato) because of the CO₂ increase. However, benefits of increased carbon dioxide concentrations in the atmosphere are limited, because stomata close and photosynthesis stops at CO₂ concentrations higher than 0. 15%.

On the other hand, C4 plants which include corn, sorghum, sugarcane and millet and many other crops are more efficient in higher bright-nesses and higher temperatures than C3 plants even though the reverse is true when light intensity is very low.

Soybean responses different amounts of CO₂

As IPCC and FAO reported in their second assessment in December 1995, the amount of production harvested from soybean fields was generally increasing by the elevated CO₂ levels Allen et al. (1987). The following table shows the percentage increases of soybean yield predicted across selected carbon dioxide concentration ranges associated with relevant benchmark points in time, adapted from Allen et al. (1987).

Period of time (years)

[CO₂] midday

Biomass photosynthesis

Seed yield

Initial

Final

(Nmd/mol)

(% increase over initial [CO₂])

IA - 17001

200

270

38

33

1700 - 1973

270

330

19

16

1973 - 20732

330

660

50

41

1 IA, the ice age is about 13 000 to 30 000 years before present. The atmospheric CO₂ concentration that prevailed during the last Ice Age, and from the end of the glacial melt until pre-pioneer/pre-industrial revolution times, were 200 and 270 μ mol/mol respectively.

2 The first world energy ' crises' occurred in 1973 when the CO₂ concentration was 330 μ mol/mol. This CO₂ concentration is used as the basis for many CO₂ doubling studies. The CO₂ concentration is expected to double sometime within the 21st century.

Conclusion

Crop production and productivity entails the management of production resources, since the world population increases demanding more food and fiber the need of utilizing the sunlight energy, water, temperature and carbon dioxide is important since plants are the ultimate source of energy for all lives on the earth. We humans and other animals cannot utilize the solar energy, only organisms that contain chlorophyll are able, but we are capable to give more attention to the factors that affect photosynthesis. The management, conservation and protection of water, land and atmosphere are the most challenging issues to realize higher and stable crop yields.

In the future, the main that the researchers discuss will be to identify and select plant species that have the ability to perform more photosynthesis and carbon dioxide assimilation for higher dry matter production. Also when more is understood from influences of the present climate changes on plant production and productivity, much money, time and effort should be invested to introduce cultivars that can adapt the environment biologically and systems to contribute the management of crop production to create more stable, sustainable and productive agricultural models.