Effects of Ultraviolet-B Radiation on Photobiology

Donald J. Pilon
C.L. Criscuolo

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Abstract

Ultraviolet-B radiation has large impacts on plants causing alteration outside and inside the plant. This also causes the plant to function irregularly and not to fullest potential. Alterations that may occur outside the plant include increase or decrease of a plant part or abnormal formation of the plant structure. The changes in the plant organelles lead to a decrease in function or ability to perform function. Some of the changes to the organelles are not a severe as other changes or have as big of an impact as other changes can have on the plant as a whole. Sometimes the amount of exposure to ultraviolet-B radiation can determine the severity of the damage done to the plant. Several factors can determine if the percent of exposure to ultraviolet-B radiation will be significant or minimum. These factors are not always used by researchers, but the factors do include altitude, weather, terrain, and environmental conditions. Also the effects of ultraviolet-B radiation are different between different species of plant. In these different species there are different forms of protect from ultraviolet-B radiation. Some protections are not as helpful to protect a plant from ultraviolet-B radiation causing the plant to still be harmed.

Key terms

ultraviolet-B radiation, Brassica campestris, Brassica carinata, Spongy mesophyll, palisade mesophyll, Medicago saliva, Setaria viridis, Avena fatua

Introduction

A number of things that inhibit growth or function of the plant can affect plants. Some of the effects from ultraviolet-B radiation may appear to be positive from just looking at the plant. For example the leaves of a certain species of plant may become larger, but on closer analysis of the plant on a cellular level, the plant has been damaged. This means that some function of the plant is being restricted for a function to be restricted an organelle of the plant must be damaged or altered by the ultraviolet-B radiation. Researchers have done experiments on different species of plants and their results were different with different species of plants. Most of these experiments showed that the plants were affected negatively by exposure to ultraviolet-B radiation.

Effects due to altitude or geological terrain are also a factor on the growth of a plant. If a plant grows at a higher altitude it will have an increase in the amount of exposure to ultraviolet radiation. Geological terrain can affect the plant because if the plant in question is a plant in the desert or some barren area then it too can be exposed to higher amounts of ultraviolet radiation. Also factors such as climate, weather, or environmental issues can be a large impact on plant growth.

Ultraviolet radiation can cause the plant to lose some form of function due to a change or changes in the plant. The alterations that may occur are the ability for the plant to create energy, the ability to grow or possibly the control of water content. Also if a change has occurred to a structure of the plant than the organelles in that particular structure have also been altered. The changes that may occur can also be less serious or different in one species of plant compared to that of another species.

Ultraviolet radiation has different effects on various species of plants. Some of these plants are affected negatively from the exposure to **ultraviolet-B radiation**. Other plants show little change from the exposure to the ultraviolet-b radiation (The Ecological, 1995) In Janet F. Bornman's and Thomas C. Vogelmann's experiments consisted of the plants being exposed to supplemental ultraviolet-B radiation or high visible light for two weeks. In the experiments **Brassica campestris** was very sensitive to the ultraviolet-B radiation, but **Brassica carinata** was not as sensitive to the exposures. This shows one way that ultraviolet-B radiation can vary in one species of plants compared to another species of plants. Also the leaves of a plant called cariiwla also showed some response to the exposure of ultraviolet-B radiation. The leaves showed a decrease in chlorophyll and an increase in leaf thickness. The chlorophyll is necessary for the plant because the plant needs chlorophyll for photosynthesis. The Brassica campestris' leaves showed an increase in light in the **spongy and palisade mesophylls**. The plant **Medicago saliva** also showed an increase light transmission trough the palisade mesophyll. The Brassica carinata had changes in the leaf's anatomy and pigments after the exposure to ultraviolet-B radiation.(VOGELMANN T, BORNMAN J. 1991) In one-article researchers believe that exposure to ultraviolet-B radiation could change the biomass allocation to plant parts or change the plant form.

In the experiment done by University of Warmia and Mazury and University of British Columbia showed a decrease in leaves and high before harvest with the increase of ultraviolet-B radiation. Most experiments that have been done show a decrease of some a function or structure of a plant with an increase of ultraviolet-B radiation. Both species were grown in a greenhouse with ultraviolet-B radiation. The specie **Setaria viridis** showed leaf curling due to high irradiation from ultraviolet-B radiation exposure (Zuk-Golaszewska K. 1995[plate1]). Setaria viridis seemed to be more affected to exposure of ultraviolet-B radiation in both experiments compared to **Avena fatua**. The Avena fatua showed some response to ultraviolet-B radiation, but not as severe as Setarea viridis (Zuk-Golaszewska K. 1995 [plate2]). Also ultraviolet-B radiation showed to be higher in plants with thin leaves compared to those with thick leaves (Zuk-Golaszewska K. 1995).

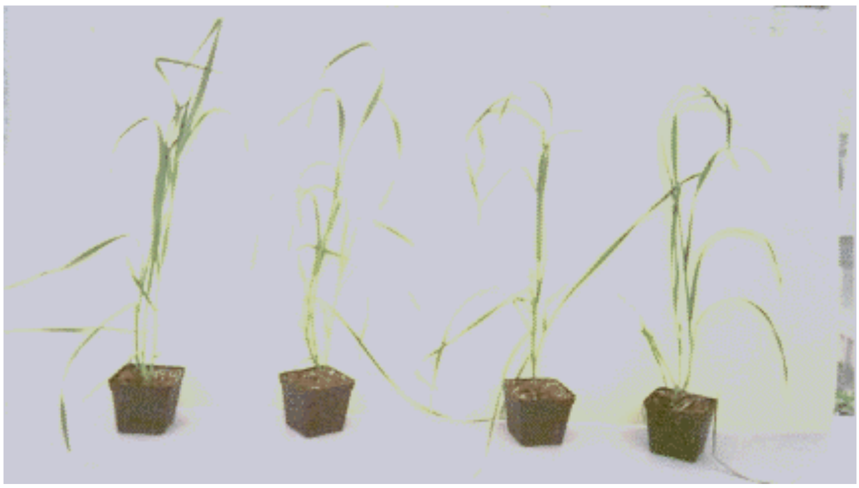
The exposure to ultraviolet-B radiation in a real world environment could be different because of altitude, geological terrain, location, and climate. Other factors that may interfere with a plants growth or functions are environmental conditions. The plant can also have a higher exposure to ultraviolet-B radiation if the plant is growing at a high altitude closer to the source of the Ultraviolet-B radiation. The percent of exposure can also increase if the plant is growing in an area with no cover from other plants or various objects such as a desert. Also if doing experiments in real world setting, the levels of smog or other pollutants that may block ultraviolet-B radiation must be taken into account. Environmental conditions that may also affect plant growth would be polluted soil or acid rain. These factors must be removed to get the most accurate results. Weather also can play a large role in exposure of ultraviolet-B radiation. If the plant grows in an area of frequent rain or overcast conditions then the clouds may block a large amount of the radiation and also if it is raining the plant will not go into a drought. Also the weather could also cause the plant to dry up if it does not rain. If what some of the researchers say about how ultraviolet-B radiation is changing plants, than environmental conditions may have as big of an impact on plants growing in the wild as well as ultraviolet-B radiation.

The plant can also be damaged on cellular or molecular level. When a structure of a plant is altered it alters the organelles of the structure which will affect how the plant functions (Stapleton A. 1992). When the leaves of cariiwla were exposed to ultraviolet-B radiation the leaves showed an increase in thickness, but the amount of chlorophyll decreased. This alteration would affect the plant's ability of photosynthesis. The exposure to ultraviolet-B radiation could also affect the plant's ability to control water content. If a plant does not have water and enters into drought then the plant cannot repair structures or damages as it could when the plant had water. Thick cell walls in plants can help shield the plant from ultraviolet-B radiation. The cuticle also helps protect plants, but in some plants does not serve as great of a protection for the plant

Discussion

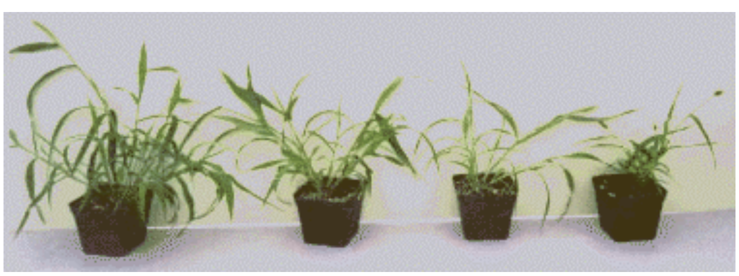
The effects of ultraviolet-B radiation may increase and cause more damage on plants. Also the damage done to the plant may increase to the point where the plant will become too altered and will not function correctly and will die off. Plants may adapt to the changes and form some kind of protection to the ultraviolet-B radiation. Plants may mutate and form something not seen before to adapt to the harmful ultraviolet-B radiation. Not many experiments have been done outside of a laboratory and this may not correctly show if any of the factors would affect the exposure percent of ultraviolet-B radiation on plants. Also doing research in plants and the affects of ultraviolet-B radiation on plants may be able to improve the human race. Plants are greatly affected by the exposure of ultraviolet-B radiation and their organelles are altered as well. If plants are affected by ultraviolet-B radiation, than humans are affected by it as well. Also if plant's organelles are altered than humans cells can just as easily be altered.

Also if factors such as weather or altitude could determine the exposure of ultraviolet-B radiation on plants, then it may be as big of a factor on humans. Humans also take in higher amounts of environmental hazards than plants do, but may not necessary be exposed to the same amount of ultraviolet-B radiation as plants are. Also humans are exposed to artificial ultraviolet-B radiation.



Avena fatua

Zuk-Golaszewska K. The effect of UV-B radiation on plant growth and development [homepage on the Internet]. 2002 June 26. [cited 2009 Apr. 10]. Available from: http://www.cazv.cz/2003/PSE3_03/8-zuk.pdf



Setaria viridis

Zuk-Golaszewska K. The effect of UV-B radiation on plant growth and development [homepage on the Internet]. 2002 June 26. [cited 2009 Apr. 10]. Available from: http://www.cazv.cz/2003/PSE3_03/8-zuk.pdf

Glossary

Avena fatua

Plant that may grow to 1.5m, found throughout Europe and Asia, the plant can grow in non-suitable growing condition soil, and also can grow in drought.

Brassica campestris

Grown mostly in colder regions, also grow quickly

Brassica carinata

Grown in Ethiopia, has 34 chromosomes.

Medicago sativa

Sickle Medick, can live for 3 to 12 years,

palisade mesophyll

One of the main sites for photosynthesis, below upper layer of many leaves.

Setaria viridis

Can grow up to 1m, the plant grows much like that of Avena fatua.

Spongy mesophyll

Below the palisade mesophyll layer, does not have a very organized structure due to the shape

ultraviolet-B radiation

Rays that come from the sun, can enter through the ozone layer unlike ultraviolet-C rays.

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