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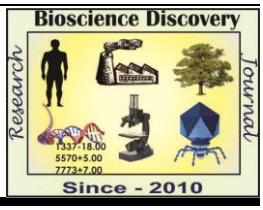

Impact of UV-B irradiation on two different Ferns

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Abstract

Pteridophytes plants *i.e; Adiantum* and *Pteris* grown in the greenhouse under the UV- B radiation had different growth habit and different reaction to UV- B irradiation.The high level of irradiation caused leaf curling, especially at the *Pteris.* As compared to control plants, there was a reduction in chlorophyll and protein content, sugar content when exposed to UV irradiation. It might be due to plant height or leaf greenness index. Generally the subsequent days of UV- B radiation, delayed plant growth and decrease in leaf area, while the Ferns of *Pteris* was much more susceptible than *Adiantum* to the UV- B radiation.

INTRODUCTION

UV-B (280-320nm) is of particular interest because although this wavelength represents only approximately 1.5% of the total spectrum, it can have a variety of damaging effect in plants. UV-A (320-400nm) represents approximately 6.3% of the incoming solar radiation and is the least hazardous part of UV radiation (Hollosy 2002). Increased UV exposure has been shown to alter the biotic relationship of the higher plants, as demonstrated by the changes in plant disease susceptibility and the balance of competition between plant species (Teramura,1983). The influence of UV radiation on growth appears to be mediated by phytohormones, either *via* photodestruction or enzymatic reaction.

Past and future climate change includes many variables such as CO_2 enrichment, increased temperature, and altered precipitation and surface UV radiation levels. These changes in climate end abiotic conditions can interact with current uses of and biotic stressors to ecosystems, (Nogues *et al.*, 1998). Alterations in surface UV radiation may result from ozone reduction/changes in atmospheric particulates and cloudiness (or both). The UV-B radiation is only absorbed by the stratospheric ozone and small part of it reach the earth surface.

Adiantum raddianum is a delicate fern native to tropical and subtropical South America. The fern grows terrestrially or on rocks and erects arching fronds, up to 50 cm high, growing out of a short rhizome. In Hawaii it was first observed around 1910 and is now the most common *Adiantum* species. *Pteris* (brake) is a genus of about 280 species of ferns in the Pteridoideae subfamily of the Pteridaceae. They are native to tropical and subtropical regions of the world. Many of them have linear frond segments, and some have sub-palmate division.

Keeping these views in mind, an attempt was made to study the effect of UV-B radiation on growth parameters and physiological or biochemical changes of two different ferns *i.e*; *Adiantum* and *Pteris.*

MATERIALS AND METHODS

The ferns viz; *Adiantum* and *Pteris* were collected from wild in Kollam district of Kerala. Plants were potted by using soil mixture (Garden soil, red soil and loam soil) in the ratio of 1:1:1.

The seedlings were transferred to the pots and kept under the growth chamber by maintaining temperature at 25ºC and watered daily.

Two sets of plants were maintained. After 30 days of growth ferns. One set of ferns *viz;Adiantum* and *Pteris* were exposed to UV light for 15 minutes at afternoon time for 3 days continuously. Other set of ferns were treated as control.

Then the UV exposed and control plants were analysed for the change in terms of growth parameters and biochemical changes viz., photosynthetic pigments, protein content (Lowry *et al*., 1951); sugar content and minerals (Vogelo's 1989). For all the experiments, replicates were maintained.

RESULTS AND DISCUSSION

Pteridophyte plants *i.e; Adiantum* and *Pteris* grown in the green house under the UV- B radiation had different growth habit and different reaction to UV- B irradiation.The high level of irradiation caused leaf curling, especially at the *Pteris.*

The mean plant height of *Adiantum* and *Pteris* was not affected in the first experiment and in the second experiment, the plants of *Adiantum* and *Pteris* were significantly affected as exposed to UV light. Generally, the subsequent levels of increased UV- B radiation delayed plant growth.

The mean plant height of *Adiantum* was the same irrespective of the UV- B radiation level, while the plants of *Pteris* was much more susceptible than *Adiantum* to the UV- B radiation.The Ferns were also different in the number of leaves, but this can be explained by natural interspecies differences (Table 1).

In comparison with the control plants, root length was not significantly changed by UV exposure. But shoot length decreased and this reduction was greater in *Pteris* as compared with *Adiantum* when exposed to alternate days of UV exposure. Generally the subsequent days of UV- B radiation, delayed plant growth and decrease in leaf area, while the Ferns of *Pteris* was much more susceptible than *Adiantum* to the UV- B radiation.Our results were positively correlated with Golszewska *et al*. (2003) observed on effect of UV-B radiation on development of *Avena fatua* and *Sataria viridis*.

The growth of many species is reduced in response to UV treatment, similar changes have been observed in sunflower and corn seedlings (Rogozhin *et al* ., 2000).

Similar changes have been observed by various physiologists *viz*: Kakani *et al*., 2003; Nogues *etal*., 1998; Yao *et al*; 2006) who worked on sunflower and corn seedlings; *Impatiens capensis, Gossypium hirsutum,Pisum sativum* and *Fagopyrum tataricum*.

Table 1. Effect of UV- B radiation on development of *Adiantum* and *Pteris*.

UV-B level (minutes)	Height of plant before harvest (cm)		Number of leaves per plant	
	Adiantum	***Pteris***	***Adiantum***	***Pteris***
Control	35	30	37	32
15	33	25	34	29
30	29	21	27	22

Table 2. Effect of UV- B radiation on mineral contents.

UV-B level (minutes)	Magnesium Content (mg/ml)		Chloride content (mg/ml)	
	Adiantum	***Pteris***	***Adiantum***	***Pteris***
Control	3.6	2.4	0.024	0.02
15	3.4	2.0	0.013	0.01
30	3.3	2.0	0.011	0.01

As compared to control plants, there was a reduction in chlorophyll, protein and sugar content and decrease in mineral contents, when exposed to UV irradiation.The reduction in chlorophyll and protein content was more greater in *Pteris* as compared to *Adiantum* plants. It might be due to plant height or leaf greenness index (Table 3 and 4).

As compared with the control treatment, UV exposure significantly increased stem thickness, which was greater in UV –C exposed plants than in UV-A- exposed plants. It was reported that this hormone decrease stem elongation and increases stem thickness (Rogozhin *et al*., 2000). In contrast, UV exposure decreased stem thickness in *Fagopyrum tataricum* (Yao *et al*., 2006).

Table . 3. Effect of UV- B irradiation on Chlorophyll and Carotenoid content in *Adiantum* and *Pteris*.

UV-B level (minutes)	**Total Chlorophyll Content (mg/g fresh wt.)**		**Carotenoid content (mg/g fresh wt.)**	
	Adiantum	***Pteris***	***Adiantum***	***Pteris***
Control	21.89	19.50	5.3	4.7
15	19.3	17.6	5.0	4.5
30	16.4	15.4	4.5	4.0

Table . 4. Effect of UV- B irradiation on Total sugars and Total protein content in *Adiantum* and *Pteris*.

UV-B level (minutes)	**Total sugar content (mg/g fresh wt.)**		**Protein content (mg/g fresh wt.)**	
	Adiantum	***Pteris***	***Adiantum***	***Pteris***
Control	4.2	3.6	5.9	4.7
15	3.9	3.3	5.4	4.3
30	3.4	3.0	4.9	4.0

The changes in plants morphology induced by UV-B may affect competition for lights (Barnes *et al*; 1988). The negative effects of UV-B radiation results in deformed morphological parameters. Exposure to UV-B decreased plant height, leaf area and plant dry weight increased auxiliary branching and leaf curling (Dai *et al*; 1995, Greenberg *et al*. 1996, Furness *et al*; 1999 and Vaclavik *et al*., 2017). Dai *et al*. (1995) reports that after a few weeks of UV-B exposure, leaf area and plant dry weight of rice were significantly reduced.

High levels of UV-B clearly decreased the relative growth rate and nitrogen productivity, as leaf area productivity and leaf nitrogen productivity were all decreased (Daniel *et al*.2004).

Plants developed different defense mechanisms against UV-radiation such as thicker and smaller leaves (Sulivian,1997). Increased production of UV-absorbing compounds such as flavonoids, anthocyanins and higher amounts of reflective waxes (Bornman and Vogelmann, 1991) .

Climate changes is going to differentially affect crop productivity in different areas of the world. Although regional climatic variations and differences in availability of natural resources make difficult the assessment of crop response at a local level based on global models. The depletion of the stratospheric ozone layer by manmade pollution the substantially increased UV-B light impinging on the earth surface.

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