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Regular Article

The effect of over exposure of Ultraviolet-B radiation on the physiological characteristics of *Aeschynomene aspera* L.

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The impacts of UV-B radiation (280- 320 nm) increasing in recent decades due to depletion of the ozone layer in the stratosphere. UV-B radiation intensity alters plant ecosystems by reducing their productivity. Penetration of ultraviolet radiation varies among the different plant species and reflect their sensitivity. The effects of UV- B radiation was studied in *Aeschynomene aspera* L. belongs to the family Fabaceae. UV-B significantly decreased the photosynthetic pigments as well as growth characteristics of the plant. Phenolic compound was increased but total sugars content were reduced in exposed leaf tissue. Protein content was initially decreased but increased on the 9th day of UV-B treatment.

Keywords: UV-B radiation, *Aeschynomene aspera*, photosynthetic pigments.

Sun is essential for sustaining life on the earth. Sunlight contains a small amount of short wavelength ultraviolet (UV) light irradiation, which is harmful to life on planet earth. Mid-range ultraviolet (almost all UV above 280 nm and most above 315 nm) is blocked by the ozone layer, and would cause much damage to living organisms if it penetrated the atmosphere. During the past eighty years the ozone layer has been damaged by the release of ozone depleting substances such as chlorofluorocarbon, hydrochlorofluoro-carbons, methyl bromide and other industrial compounds containing halogens (Krizek, 1998). Numerous studies have investigated the effects of over exposure of UV-B on plants, and diverse range of responses were found, including changes at the physiological, morphological, biochemical and molecular levels (Paul, 2001). The penetration of ultraviolet radiation depends on the plant species and it reflects their sensitivity. In nature plants and other organisms are affected by a stress factor. They respond to several factors such as water stress, increased CO_2, mineral nutrient availability, heavy metals, air pollution, and temperature (Caldwell *et al.*, 1998). The amount of solar radiation absorbed by a leaf is a function of the photosynthetic pigment; chlorophyll content can directly determine photosynthetic potential and primary production. It has been reported that UV-B stimulated the biosynthesis of UV-B absorbing compounds and carotenoids, which both perform a photo protective function (Campos *et al.*, 1991). Indrajith and Ravindran (2009) suggested that *Phyllanthus amarus* is resistant against UV-B radiation damage and the possible negative effect of additional UV-B radiation on the growth of seedling may have been effectively

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balanced by the UV-B radiation stress through increase in UV absorbing compound and antioxidant enzymes.

Pedro Cuadra *et al*. (2004) reported that UV-B irradiated plants showed morphological, biochemical and genetic differences compared to non-irradiated plants. Spectrophotometric analysis of UV-B radiation decreases the chlorophylls content, and increases the amount of UV-B absorbing compounds (e.g., phenyl-propanoids). Leaf area and leaf thickness, quantitative and qualitative changes in protein, flavonoid composition and the change in chlorophyll levels, in potato leaves exposed to UV-B radiation were studied by Santos *et al*. (2004).The aim of the work is to investigate the effect of UV-B radiation on photosynthetic pigments, biochemical constituents and to estimate the phenolic compound. The plant material selected for the study is *Aeschynomene aspera* L. Belonging to family Fabaceae. It is a tall erect sub shrub in swampy areas, with stout nodular stems. It is also known by the names Sola, Sola Pith Plant, Pith Plant, Laugauni or Netti.

Materials and methods

Collection of plant sample

Aeschynomene aspera seeds were collected from Tamil Nadu Agricultural University Coimbatore. Seeds were soaked in water for one day and then transferred to garden soil in trays, containing red earth, sand and farmyard manure in (1:2:1). UV-B radiation was provided by UV lamps which are above 15cm and control is maintained. Control was exposed to normal day light. Seedlings were irradiated for 1 hour per day (12.30 pm to 1.30 pm) for 9 days.

Analysis of growth characteristics

Growth parameters such as root length and total length of the seedlings, fresh weight were measured immediately after the removal of seedlings from the experimental pots.Randomly sampled plants are dried at room temperature and measured the dry weight after 24 hour.

Estimation of photosynthetic pigments

Chlorophyll content was estimated by using Moran and Porath Method (1980). 0.5 gram (W) of fresh leaves was smashed with 80% Acetone. Then collected 5ml (V) filtrate and estimated pigments such as chlorophyll A, chlorophyll B, total chlorophyll and Carotenoid at different wavelength (480nm, 647nm and 666nm).

Estimation of biochemical constituents

Estimation of Protein:

The protein content was determined by Lowry *et al.* (1951) method. 0.5 gm of leaves was smashed with 80% Acetone. This extract was used as a sample. 0.3 ml of extract was diluted to 1 ml. Then 2 ml of Reagent D was added to it and incubated it for 10 minutes at room temperature. 0.6 ml of Reagent E was added and incubated it for 20 minutes at room temperature. Absorbance was read at 660nm with bovine serum albumin as a standard.

Estimation of total sugars:

Total sugars were estimated by phenol sulphuric acid method. 0.5 gm of leaves was smashed with 80% Acetone. This extract was used as a sample.0.3 ml of extract was diluted to 1 ml and to that 0.5ml of 80% phenol, 4 ml of con.H_2O_4 were added and absorbance was read at 490 nm. Concentration of Total sugars was determined using glucose as standard and plotted the graph.

Estimation of Total phenolic content

The total phenol content was determined spectrophotometrically using the Folin–Ciocalteu method. Singleton and Rossi (1967) is a colorimetric oxidation / reduction method for phenolic compounds. 0.2 ml of the sample was diluted to 1 ml.0.7 ml of Folin–Ciocalteu reagent was added to it and incubated 5 minutes at 22^0C.Then 1 ml of Na_2CO_3 was added and again incubated at 22^0 C for 90 minutes. The absorbance was measured at 725 nm. The Standard Graph was prepared using Catechol.

Results and Discussion

Growth characteristics

Aeschynomene aspera L. was treated under UV-B radiation showed different reaction on growth characteristics, photosynthetic pigments and antioxidant enzymes. The irradiation caused morphological changes such as leaf curling and foliar damage. After 9 days of UV-B treatments growth characteristics such as root length, total length of the seedlings, fresh weight and dry weight were reduced to 7.7%, 24.7%, 37.2%, 60% respectively. The mean plant length was found to be decreased in UV-B treated plant than the control. Due to decrease in photosynthetic rate, dry weight of UV-B treated plant was found to be decreased. The effects of UV-B on growth characteristics were shown in the (Table 1).

Table 1: Effects of UV-B radiation on total length, shoot length, fresh weight and dry weight on *Aeschynomene aspera* L.

Days	Treatments	Total length (cm)	Root length cm)	Fresh weight(gm)	Dry weight (gm)
3	Control	12.8 ± 0.55	3.93 ± 0.75	0.16 ± 0.02	0.05 ± 0.15
	UV-B	9.66 ± 0.45	3.63 ± 0.40	0.10 ± 0.01	0.02 ± 0.01
6	Control	15.8 ± 0.90	4.06 ± 0.8	0.20 ± 0.04	0.09 ± 0.01
	UV-B	10.33 ± 0.35	3.63 ± 0.30	0.141 ± 0.20	0.02 ± 0.02
9	Control	17.6 ± 0.65	7.53 ± 0.41	0.48 ± 0.08	0.02 ± 0.01
	UV-B	11.03 ± 0.15	5.46 ± 0.37	0.191 ± 0.07	0.08 ± 0.04

Results are mean ± S.E. of 3 replicates.

Photosynthetic pigments

UV-B radiation significantly reduced the chlorophyll content and carotenoid. This is because photosynthetic pigments were destroyed by UV radiation. The chloroplast is the first organize to show injury response when irradiated with UV-B radiation Campbell (1975). In UV-B exposed plants maximum chlorophyll content (chlorophyll a, chlorophyll b and total chlorophyll) were initially increased on the 3rdday then gradually reduced. Reduction in chlorophyll a and chlorophyll b content about 42.7%, 72.3% respectively. Santos *et al.* (2004) found the significant decrease in total chlorophyll content of potato leaves as compared to unexposed leaves.

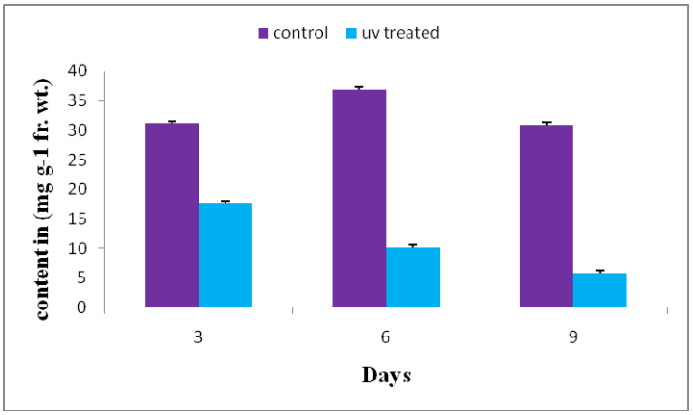

Figure1: Effect of UV-B radiation on the synthesis of Chlorophyll a

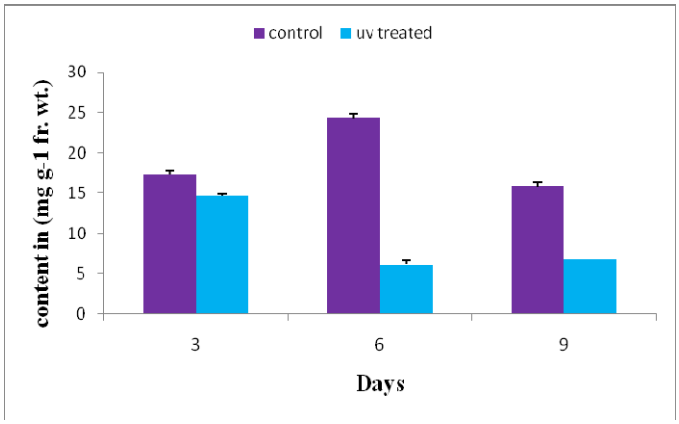

Figure2: Effect of UV-B radiation on the synthesis Chlorophyll b

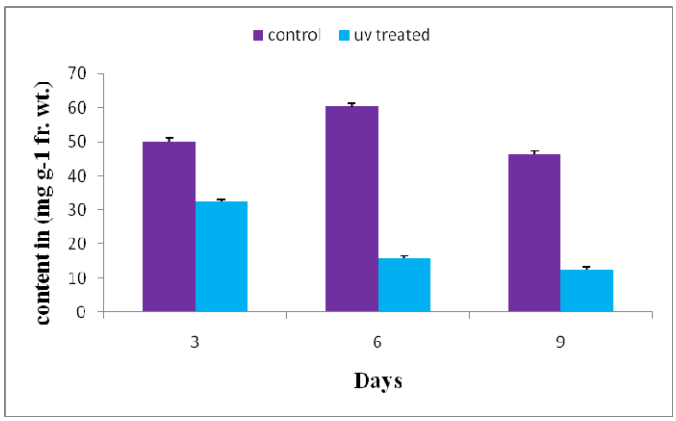

Figure3: Effect of UV-B radiation on the synthesis of total chlorophyll

Carotenoid content also decreased to 24%. The reduction in carotenoid content may result either from inhibition of synthesis or from break down of the pigments reported by Salisbury and El-Mansy (1971).Since, the carotenoid are involved in the light harvesting and protection of chlorophyll from photo oxidative destruction, any reduction in carotenoid could have serious consequences of chlorophyll pigments.

Biochemical constituents

Biochemical constituents such as proteins, total sugars, total phenols were determined. UV –B radiation leads to modification in Protein, carbohydrate and phenolic contents. When compared with control plants, UV treated plants showed less protein content on the 6th day but were increased on 9th day and shown in the figure 5.

Total sugars was determined by phenol sulphuric acid was initially increased in UV treated plants but decreased on the 9th day was 1.42mg/ml and shown in figure.6. Total phenolic content determined by Folin-Ciocalteau method was gradually increased in the UV treated plants on 6th day and 9th day was 0.02mg/ml and 0.08mg/ml. The accumulation of phenols were shown in the figure.7

Conclusion

The penetration of ultraviolet radiation varies among different plant species and may reflect their sensitivity. In this study we found the effects of UV-B on *Aeschynomene aspera* L. The results showed the 9 days of UV-B treatment affected the growth parameters and photosynthetic pigments. Chlorophyll and carotenoid content were reduced thus photosynthetic

pigments were destroyed by UV radiation. Significant changes were found in the biochemical constituents such as proteins, total sugars, total phenols. Total sugar content was decreased but phenolic content and proteins were accumulated in UV-B exposed plant.

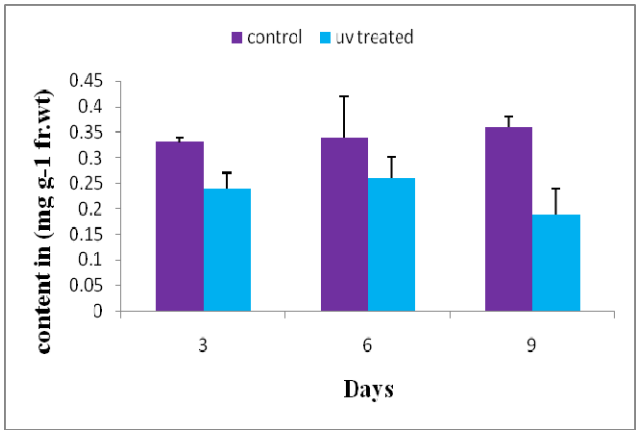

Figure4: Effect of UV-B radiation on the synthesis of carotenoid content

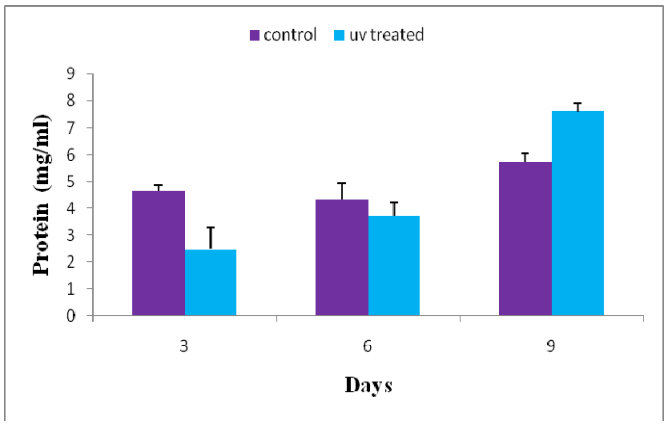

Figure.5 Effect of UV-B radiation on protein content

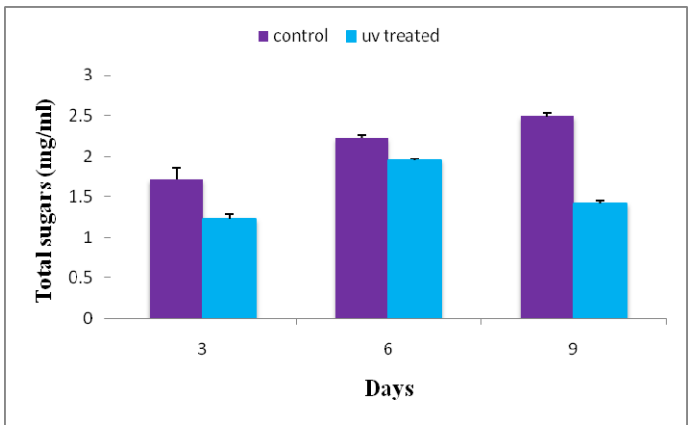

Figure 6: Effect of UV-B radiation on total sugars

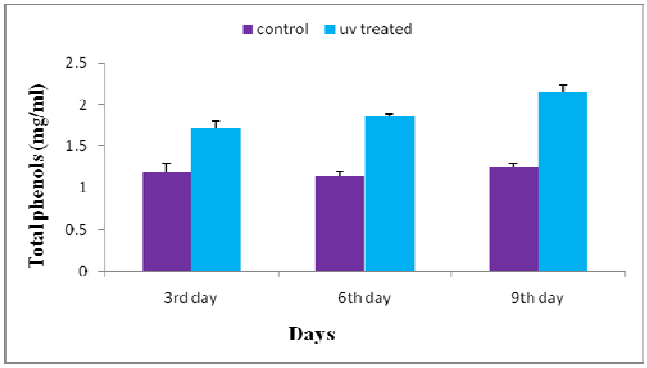

Figure7: Effect of UV-B radiation total phenolic content

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