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IMPACT OF ULTRAVIOLET-C RADIATION ON SEED GERMINATION AND CHLOROPHYLL CONCENTRATION OF SOME WOODY TREES GROWN IN SAUDI ARABIA

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ABSTRACT

Constant reduction of stratospheric ozone layer and the increase of ultraviolet radiation intensity were observed in last twenty years of the 20th century. Four tree species; *Acacia amplicepsis*, *Acacia gerradii*, *Casuarina glauca* and *Eucalyptus intertexta* grown in Experimental station of Food and Agriculture Sciences Collage, King Saud University were used to study the impact of UV-C on potential of seed germination and chlorophyll concentration. The result obtained has indicated that, UV-C (254nm) affected significantly the seed germination and chlorophyll concentration. Increased UV-C exposure periods can decrease the chlorophyll A, chlorophyll B and chlorophyll A + B concentrations of seedling of studied species. Similarly, seed germination was also sensitive to high dose of UV-C radiation. *Acacia ampliceps* was significantly higher in two experiments than the other species in seed germination and chlorophyll A, B and A+ B concentrations. The UV-C exposure periods in the two experiments showed that the exposure periods were highly significant. Moreover, the most affective exposure period on the seed germination was 72 hours. As for the chlorophyll concentration, the control treatment (No exposure) had the highest chlorophyll A, B and A+ B concentrations than the other UV-C exposure periods. The most detrimental exposure period was found at 120 minutes. Chlorophyll ratio was varied among the tree

species. *Acacia gerradii* had the highest chlorophyll ratio than the other tree species in the two experiments. In the first experiment, 30 minute exposure period gave the highest chlorophyll ratio, while the lowest chlorophyll ratio was found on control treatment. In contrast, in the second experiment, the highest chlorophyll ratio was found on control treatment (No exposure) and the lowest chlorophyll ratio was 120 minutes. From the results, it is clear that *Acacia ampliceps* was the most tolerant to the exposure to the Ultraviolet-C (254 nm) radiation and had the highest chlorophyll concentrations, while *Eucalyptus intertexta* was the most sensitive to same dose of radiation.

Key Words: *UV-C, woody trees, Seeds, Germination, Chlorophyll concentration, Saudi Arabia .*

INTRODUCTION

Plants are liable to be exposed to various abiotic and biotic stress factors throughout their life time, yet same of them can adapt to changing environmental by different morphological, physiological and chemical means (Walling, 2000 and Diaz *et al*., 2007). The decrease in stratospheric ozone and the resulting increase of solar ultraviolet have become a general worldwide concern in the last few decades. Solar ultraviolet radiation is highly dynamic abiotic environmental factor of major importance, which serves as an essential cue for growth and differentiation processes in plants (Paul and Gwynn-Jones, 2003). Ultraviolet (UV) radiation is electromagnetic radiation of a wavelength shorter than that of the visible region, but longer than soft X-rays. It can be subdivided into near UV (380-200 nm wave length) and extreme or vacuum UV (200-10 nm). The range of UV wavelength is often subdivided into UV-A (380-315 nm), called long wave or black light; UV-B (315-280nm); called medium wave; and UV-C (280-10 nm) called short wave or germicidal. The V-UV and UV-C to the solar spectral irradiance is low, their ability to cause biological damage is high because of the energies associated with these short wave lengths. When plants are not acclimatized or are irradiated with UV level above the current ambient radiation, this radiation can have detrimental effects on proteins, lipids and specifically affect the photosystem by damaging its membranes and decreasing enzyme activities and photosystem rates (Rozema *et al*., 1997; Sullivan *et al*., 2003 and Bassman, 2004). Many fruits, flowers and seeds stand out more strongly from the background in ultraviolet wavelengths as compared to human. The plant seeds are stored desiccated under conditions of low temperature and vacuum. Solar UV irradiation had the most deleterious effect on organisms (Horneck, 1993 and Horneck *et al*., 1995). Numerous studies have demonstrated that increased UV-B can directly or indirectly affect the growth of plants (Joshi *et al*., 2007 and Feng *et al*., 2007). Relatively little information was available on the effect of VU radiation on forest tree species (UNEP, 1998). Tropical forests, though representing nearly one half of global productivity and much of the total tree species diversity, have received very little attention with respect to the ozone reduction problem. There is some information for mid-temperate latitude tree species; because they are long-lived trees present the opportunity to observe the longer-term cumulative effects of UV-B exposure over several years for the same individuals (UNEP, 1998). A few studies have been undertaken to investigate the effects of UV radiation on tree seeds germination and chlorophyll concentration. The objective of the present study was to study the impact of UV-C (λ= 254 nm.) on germination and chlorophyll concentration of some woody tree seeds growing under the dry conditions in kingdom of Saudi Arabia.

MATERIAL AND METHODS

This study was carried out in Forest physiology laboratory and Greenhouse of Plant Production Dept., Food and Agriculture Sciences Collage, King Saud University, from October 2008 to May 2009 in two experiments repeated under the same laboratory conditions, to study the effect of Ultraviolet radiation on germination and chlorophyll concentration of some woody trees grown in Experimental station of Food and Agriculture Sciences collage at Derab. A total of four woody tree species; *Acacia amplicepsis*, *Acacia gerradii*, *Casuarina glauca* and *Eucalyptus intertexta* were used in the present study.

Seeds used in the study

Seeds of four tree species (mentioned above) grown in Experimental Station of Food and Agriculture Sciences Collage at Derab, were collected from Nursery of Forestry Division were used in the study. The seeds were collected from the trees and stored at room temperature until used.

Ultraviolet irradiation treatments

The UV 254 source was a low pressure mercury lamp (no filter) (VL.215 C, Vilber Lourmat), producing a sharp peak at 254 nm. It consisted of a single tube bent beck upon itself to provide UV from five parallel sections of tubing. Exposure was preformed in a chemical fume hood that drew air across the sample and shielded the exterior with a glass sash. The source output (≈ 12mW/ccm²) was monitored with a radiometer (Vilber Lourmat VLX 254), equipped with a sensor for λ=254nm. The lamp was positioned 5 cm above seed samples. The control samples were covered with a glass microscopic slide which did not transmit UV at 254nm. The temperature was 22-25°C during the UV exposure, and flux of UV light was regularly measured. The time of UV exposure varied from 6 hours (1.4×10^3 KJ/m²) to 72 hours (1.68×10^4 KJ/m²). After exposure of seeds, they were immediately stored at 4°C until the germination assessment was carried out.

Germination assay

Fifty seeds of *Acacia amplicepsis* and *Acacia gerradii* in triplicate were pretreated before germination to break the dormancy of the seeds by using hot water treatment for 24 hours until the seeds were swilling and 0.1g of seeds *Eucalyptus intertexta* (about 300 seeds) and 30 seeds in triplicate of *Casuarina glauca* were placed in 11 cm diameter, deep Petri dishes. To each dish, 50 ml of distilled water was added and incubated at a temperature-controlled room (25°C, 16-hours photoperiod, and cool-light fluorescent tubes). Germination was expressed as the moment the root radical emerged from the seed coat. It was scored periodically every 12 hours, and percentage of germinated seeds was calculated.

UV irradiation on germinated plantlets

seven days-old germinated seeds in duplicate of *Acacia amplicepsis*, *Acacia gerradii*, *Casuarina glauca* and *Eucalyptus intertexta* were placed in different 11 cm pots under a low pressure mercury UV lamp (no filter), producing a peak at 254 nm for 10, 30, 60 and 120 minutes daily. The exposure was preformed in chemical fume hood that drew air across the samples. The lamp was positioned 10 cm above the seedlings. The temperature was 25C° during the UV exposure. After the exposure, the seedlings and the control seedlings were placed into the climate controlled growth room. The growth of the samples was followed for 15 days during which time, replenishment of the distilled water (100 ml every 2 days) to prevent dryness. Leaf samples were collected from the seedlings to analyze chlorophyll content.

Extraction of chlorophylls from leaves with N,N-dimethylformamide (DMF) method.

Tree seedlings (4 weeks-old) were grown on pots in a green-house. For chlorophyll analysis, weight of leaflets of the tree species studied were ranged between 0.025g to .035 g to extract chlorophylls with *N*, *N*- Dimethylformamide (DMF), by grinding with 2 ml of solvent DMF in a mortar with pestle. The homogenate, combined with a further three washings of the pestle and mortar (each of 1.5 ml) with the same solvent, was centrifuged at 2500 r.p.m. in bench centrifuge for 10 min. The pellet was then extracted with a further 1 ml of solvent in homogenizer and the pooled supernatants adjusted to a final volume of 8 ml. The spectrum was recorded between 750 and 600 nm. and the major red absorption peak automatically determined by the Pharmacia Biotech, Ultrospec2000, UV/visible spectrophotometer recording spectrophotometer zeroed at 750 nm. The Chls *a*, *b*, Chls *a* + *b* concentrations in µmol/L and Chls ratio were then calculated using the equations described below (Porra *et al*., 1989):

$$\text{Chl. } a = 13.43\,A^{663.8} - 3.47\,A^{646.8}$$

$$\text{Chl. } b = 22.90\,A^{663.8} - 5.38\,A^{646.8}$$

$$\text{Chl. } a + b = 19.43\,A^{663.8} - 8.05\,A^{646.8}$$

$$\text{Chl. } Ratio = \text{Chl } a \,/\, \text{Chl } b$$

Statistical analysis

The split plot design was used in analyzing the data as described by Snedecor and Cochran (1967). Statistical analysis was carried out on the data of the first and second experiment. The least significant difference method at 95% level of probability ($L.S.D_{0.05}$) was used to test the differences among the means of each parameter. The data was exported to a PC-SAS data set for statistical analysis.

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RESULTS

I. Effect of Ultraviolet-C irradiation and exposure periods on seeds germination:

UV irradiation had significant effects on the germination of studied tree seeds. The data obtained from the two experiments indicate that, highly significant differences were found among tree species (*Acacia ampliceps, Acacia gerradii*, *Casuarina glauca* and *Eucalyptus intertexta)* and exposure period, while the interaction between the species and the UV-C exposure period was not significant. Germination of *Acacia ampliceps* was significantly higher in two experiments than the other species. In the first experiment, germination mean averages were 87.67%, 74.10%, 57.84% and 55. 34 % for *Casuarina glauca*., *Eucalyptus intertexta* and *Acacia gerradii* respectively, while in the second one, *Acacia gerradii* displayed germination level higher than of *Eucalyptus intertexta* with averages of 58.70% and 57.98% respectively (Table1).

Table (1): Effect of UV-C radiation on germination of tree seeds in two separated experiments.

Species	**First Experiment**	**Second Experiment**
	Germination (%)	
Acacia ampliceps	87.67	83.13
Acacia gerredii	55.34	58.70
Casuarina glauca	74 .10	61.37
Eucalyptus intertexta	57.84	57.98
L.S.D.	**3.68**	**4.32**

The UV-C exposure periods in the two experiments showed that the exposure periods were highly significant. The control treatment (no exposure) was significantly differed than the other studied exposure periods. Moreover, the 6 hours exposure period was significantly differed but, it was highly differed than the 24, 48 and 72 hours exposure periods. The most affective exposure period on the seed germination was 72 hours, while the lowest one was for 6 hours (Table 2 and Fig. 2).

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Table (2): Effect of UV-C exposure period on tree seeds germination of the two separated experiments.

UV-C exposure period	**First Experiment**	**Second Experiment**
	Germination (%)	
Control	80.10	80.27
6 hours	69.66	66.25
24 hours	65.16	63.96
48 hours	66.52	59.94
72 hours	62.25	56.04
L.S.D.	**4.11**	**4.83**

The trend obtained for the first and second experiment of exposure to Ultraviolet 254 nm. radiation is nearly the same. From the results, it is clear that the *Acacia ampliceps* seeds were the most tolerant to exposure to the Ultraviolet 254 nm radiation, while *Acacia gerradii* and *Eucalyptus intertexta* seeds were the most sensitive to such radiation (Fig.1).

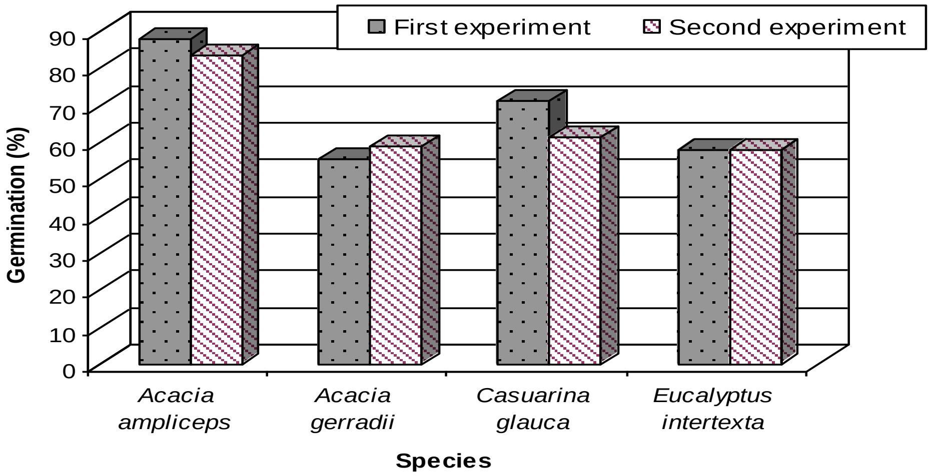

Fig. (1): Effect of UV-C on germination of tree species on two experiments.

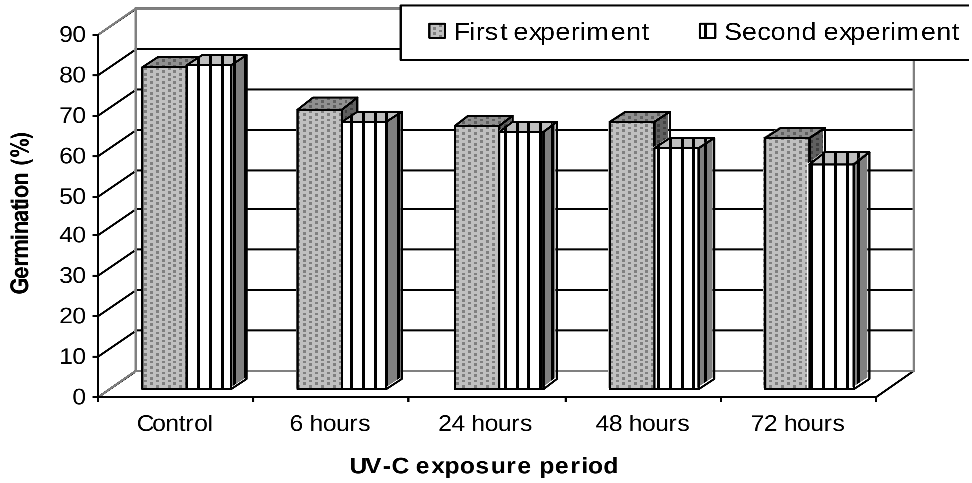

Fig. (2): Effect of UV-C exposure period on seed germination on two experiments.

II. Effect of Ultraviolet-C and exposure periods on Chlorophyll concentration:

The effect of UV-C radiation on chlorophyll concentration of *Acacia ampliceps, Acacia gerradii*, *Casuarina glauca* and *Eucalyptus intertexta* were investigated experimentally. The results showed that highly significant differences were found among the tree species and exposure period to UV-C (254nm), while no difference was found in interaction between tree species and UV-C exposure period on chlorophyll concentration. *Acacia ampliceps* displayed highest chlorophyll A, B and AB concentrations, since it was averaged 11.8, 3.11 and 14.9 µ mol/L, respectively as compared with those, *Acacia gerradii*, *Casuarina glauca* and *Eucalyptus intertexta* in the first experiment (Table 3). Nearly the same results were obtained in the second experiment; since *Acacia ampliceps* had the highest chlorophyll concentrations than the other tree species (Table 3 and Figs. 3, 4 and 5).

Chlorophyll ratio was differed among the tree species, *Acacia gerradii* had the highest chlorophyll ratio (4.92 and 4.16) than the

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Casuarina glauca (4.84 and 4.00), *Acacia ampliceps* (3.93 and 3.55) and *Eucalyptus intertexta* (3.43 and 3.27), respectively in the first and second experiment, respectively. (Table 3 and Fig. 6)

Table (3): Effect of UV-C on chlorophyll concentration of leaves of tree species studied in two separated experiments.

Species	First Experiment (µ mol/L)			
	Chl A	**Chl B**	**Chl A+b**	**Chl Ratio**
Acacia amplisips	11.8	3.11	14.9	3.93
Acacia gerredii	9.68	2.20	11.9	4.92
Casuarina glauca	8.77	1.97	10.7	4.83
Eucalyptus intertexta	8.07	2.38	10.5	3.43
L.S.D.	1.05	0.48	1.33	0.74
	Second Experiment (µ mol/L)			
	Chl A	**Chl B**	**Chl A+b**	**Chl Ratio**
Acacia amplisips	10.6	3.02	13.7	3.55
Acacia gerredii	10.2	2.53	12.8	4.16
Casuarina glauca	8.66	2.14	10.8	4.00
Eucalyptus intertexta	6.62	1.99	8.60	3.27
L.S.D.	0.69	0.40	0.78	0.56

Chl : Chlorophyll

The effect of UV-C exposure periods on chlorophyll concentrations was studied and the results obtained from the present study indicated that, the control treatment (No exposure) had the highest chlorophyll A, B and AB concentrations than that obtained by impact of the other UV-C exposure periods. The most affected exposure period was found at 120 minutes exposure period (Table 4).

On the other hand, chlorophyll ratio was differed among the tree species and exposure periods. In the first experiment the 30 minute exposure period gave the highest chlorophyll ratio followed by the 60 minute, while the lowest chlorophyll ratio was found on control treatment with average 3.66. In contrast in the second experiment, the highest chlorophyll ratio was found on control treatment (No exposure) followed by 1à minute UV-C exposure period, 30 minutes, 60 minutes and the lowest ratio was 120 minutes (Table 4). Overall, the germination and chlorophyll concentrations were highly significantly affected by UV-C radiation and exposure period.

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Table (4): Effect of UV-C exposure period on chlorophyll concentration during the two experiments.

Treatments	**First Experiment (µ mol/L)**			
	Chl A	**Chl B**	**Chl A+b**	**Chl Ratio**
Control	13.9	3.97	17.8	3.66
10 minuts	11.2	2.76	14.0	4.29
30 minuts	9.41	2.10	11.5	4.65
60 minuts	7.54	1.80	9.34	4.49
120 minuts	5.90	1.44	7.34	4.31
L.S.D.	1.17	0.53	1.48	0.83
	Second Experiment (µ mol/L)			
	Chl A	**Chl B**	**Chl A+b**	**Chl Ratio**
Control	14.1	3.47	17.5	4.31
10 minuts	9.64	2.60	12.2	3.85
30 minuts	9.38	2.51	11.9	3.75
60 minuts	7.34	2.09	9.43	3.58
120 minuts	4.74	1.44	6.17	3.26
L.S.D.	0.78	0.45	0.87	0.63

Chl: chlorophyll

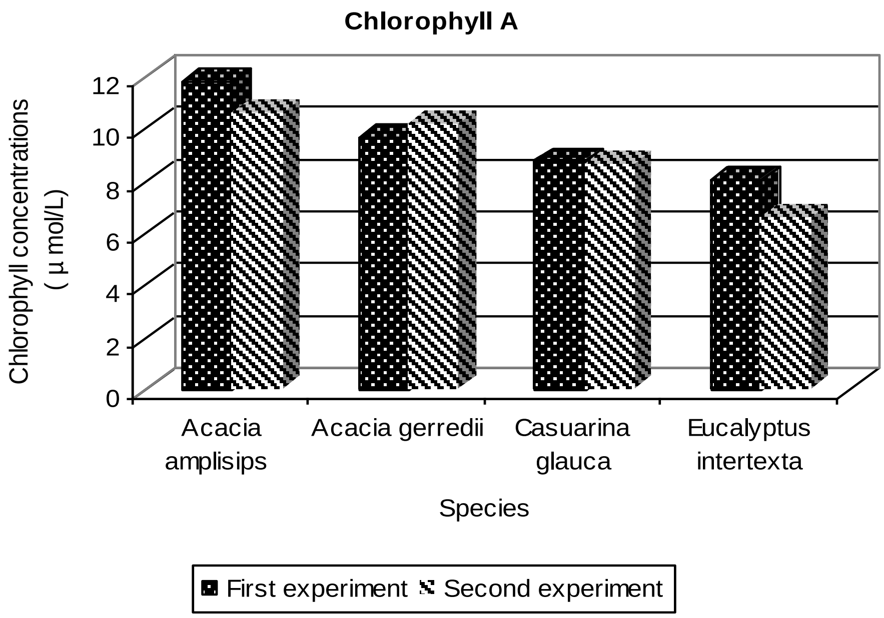

Fig. (3): The effect of UV-C radiation on chlorophyll A concentration in two separated experiments.

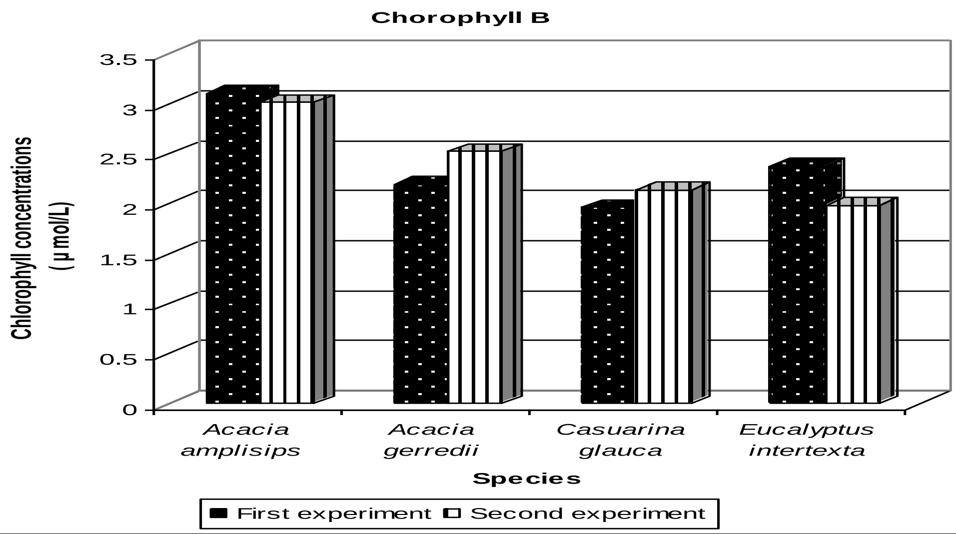

Fig.(4): The effect of UV-C radiation on chlorophyll B concentration of the two experiments.

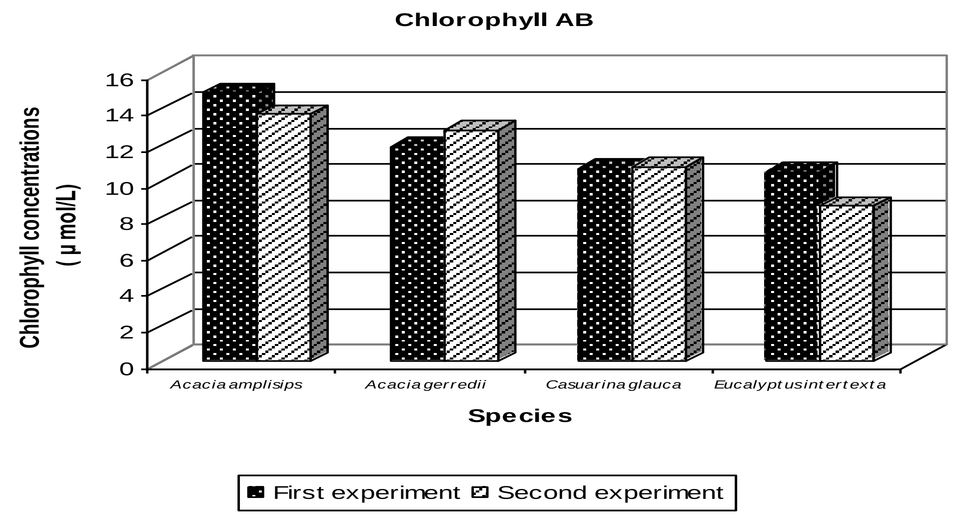

Fig.(5): The effect of UV-C radiation on chlorophyll AB concentration of the two experiments.

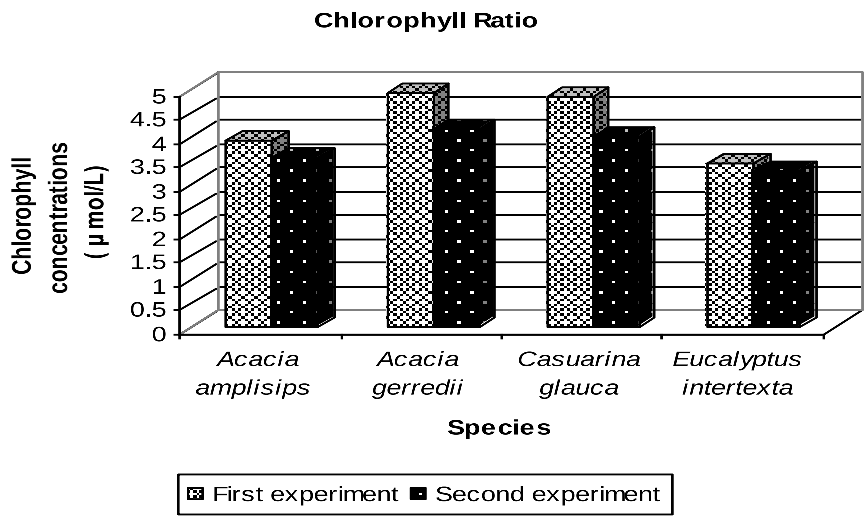

Fig.(6): The effect of UV-C radiation on chlorophyll ratio of the two experiments.

DISCUSSION

The impact of ultraviolet-C radiation on seed germination and Chlorophyll concentration of some woody trees grown in Saudi Arabia was studied. The results obtained indicated that, UV 254nm affected significantly seed germination and chlorophyll concentrations. Increased UV-C radiation (exposure periods) can decreased chlorophyll A, B and chlorophyll A+B concentrations of of *Acacia ampliceps*, *Acacia gerradii*, *Casuarina glauca* and *Eucalyptus intertexta* seedlings. Similarly, seed germination was responded sensetively to increase to UV-C radiation. These results are in agreement with those of Kakani et al., (2003); Hinokuchi and Hashimoto, (2005); Shetta, (2008) and Liu and Zhong, (2009). In the present study, it clear that, longest exposure period of UV-C irradiation caused inhibition or reduction of germination level of seeds and reduced chlorophyll concentrations. Effect of exposure to UV-C irradiation on seed germination and chlorophyll concentrations on seedlings of woody trees were highly depended on the developmental stage in which trees were confronted with the different environments (Kuhlmann and Muller, 2009). The efficient protection against UV, plant and trees are well known to respond with an induction of flavonoids and hydroxycinnamic acids (Harborne and Williams, 2000; Kolb *et al*., 2001 and Close and MCArthur, 2002). The environment during germination and early growth of tree seedlings obviously had a rather formative impact (Gedroc *et al*., 1996 and Sultan, 2000). The amount of UV radiation reaching the earth's surface can vary strongly and is highly dynamic (Paul and Gwynn-Jone, 2003), therefore the sensory perception of plants must be quite sensitive and well adapted to enable rapid changes of phenolypic appearance by acclimatizing to the current environment. Distinct levels of radiation at time of seeds germination and seedling emergence have be shown to effective significantly (Tevini *et al*., 1983; Ballaré *et al*., 1996 and Saile-Mark and Tevini, 1997). (Li *et al*., 2009) found that a significant inhibitory effect on germination rate of crop seed, *Mecicago sativa*, treated with an enhanced UV-B, while in radish seed (*Raphanus sativus*), there was no significant reduction in germination rate at any UV radiation and level in their leafs extraction. Pliura *et al*. (2008) stated that the exposure to UV-B radiation decreased genetic variation at the stage of seed germination, while a complex of UV-B and O_3 caused an increase of genetic variation at the stage of intensive seedling growth in silver brich. In separate experiment with *Ceratonia siliqua*, *Laurus nobilis* and *Cistus creticus*, no significant impact on growth would be detected when seedlings were raised under identical conditions (Stephanou and Manetas, 1998 and Bacci *et al*., 1999).

The reproductive output of woodland population was more detrimentally affected by exposure to UV. Also, all seeds were exposed to natural radiation; the small amount of radiation would have no effect on the seeds or plant (Searles *et al*., 1995 and Weining and Schmitt, 2001). The plant seeds are at least 10^5 times more resistant to UV254nm than the most bacterial spores known. The germination was decreased with increasing time of treatment, even if seeds were not exposed to UV254 (Link *et al*., 2003, Zalar, 2004 and Shetta, 2008). Seed are also protected against UV irradiation by the seed coat that contains UV–absorbing compound, such as flavonoids and other polyphenolics. The interior parts of the seed are thus shielded away from UV and other deleterious factors (Tepfer *et al*., 2003). The most effective exposure period was 72 hours, while the lowest exposure one

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was 6 hours did not affect greatly the germination of the seeds. The UV-B reduced vegetative growth and the seed resulted from the plants which previously exposed to UV-B tended to be light (Day *et al.*, 2001).

However, the obtained results disagreed with those of Noble (2002), who found that the UV light sped the germination of the kale, cabbage, radish and agave seeds. This due to the fact that the UV-B photons are more energetic than the visible light and have a stronger effect on surface of plant cells (Kovàcs and Keresztes, 2002). Toma and Boya (1999) found that a seven hours exposure to any of the laser, UV and MF significantly increased the germination of the lentils seeds. Geberscik *et al.*, (2002) found that, enhanced UV-B radiation affected water relation and production of buckwheat, but not potential of seeds for germination. Stephanou and Manetas (1998) found that the UV-B supplementation led to increase seed number and total seed mass per plant considerably, while germination rates of produced seeds were not affected. The hypothesis of a higher polyphenolic content and thicker sclerenchymatous cylinder in the pericarp of ray than of disc seed morphs of *Dimorphotheca pluvialis* could limit possible damage to the embryo during long-term seed exposure to solar UV-B radiation was tested by (Musil, 1994) with irradiating sun-dried disc and ray diasporas continuously for 6 weeks with four different doses of biologically effective UV radiation .The results indicated that irradiation of diasporas with enhanced UV-B improved germination in both seed morphs, but decreased its photochemical efficiency. Griffen *et al.* (2004) found that the UV-B did not affect individual seed mass or the concentration of UV-B absorbing compound, but the testa mass was decreased by about 18% and increased by about 158% in concentration of UV absorbing compound in the testa. Moreover, significant change in seed quality was found.

Increased UV-C radiation (exposure periods) can decrease the chlorophyll A, chlorophyll B and chlorophyll A+B concentrations of seedlings of studied species. The effect of UV-B radiation on concentrations of chlorophyll, carotenoids and soluble protein was studied by Vu *et al.*, 1982 under greenhouse conditions during the period of 8 to 43 days after leaf emergence and exposure to UV-B for 6 hours daily. Continuous exposure of soybean plants to UV-B radiation caused significant depression in of chlorophyll and carotenoids content. The pigment analysis of leaf extracts showed no effect of enhanced UV radiations on chlorophyll content and accumulation of UV absorbing (Tosserams and Rozema, 1995).This result was disagrees with that found in this study. The significant effect of UB-B/C radiation on photosynthesis and chlorophylls on carotenoids was detected which protects chlorophyll from damage. The UV-B/C and gamma irradiation damage these systems and gave differential loss in various photosynthetic activities (Kovàcs and Keresztes, 2002).

From the results, it is clear that *Acaci ampliceps* seeds were the most tolerant to the exposure to the ultraviolet (254 nm.) radiation, while *Eucalyptus intertexta* seeds were the most sensitive. Chlorophyll A, B and A+ B concentration of *Acacia ampliceps* were higher than those found in the other studied trees after exposure to UV-C in different treatments, while the Chlorophyll ratio was varied among the tree species in the two experiments.

CONCLUSIONS

The UV-C radiation (254nm.) affected significantly both of seed germination and chlorophyll concentration. Increased UV-C radiation (exposure periods) can decrease chlorophyll A, chlorophyll B and chlorophyll A+B concentration of the seedlings. Seed germinations are also a sensitive to respond to increase to UV-C radiation. Increased exposure periods can decrease chlorophyll A, chlorophyll B and chlorophyll A + B concentration of seedling of studied species. *Acacia ampliceps* was significantly higher in both experiments conducted than the other species in seed germination and chlorophyll A, B and A+ B concentration. The UV-C exposure periods in the both of experiments were highly significant and the most affective exposure period on the seed germination was 72 hours, while the lowest one was 6 hours. As for the chlorophyll concentrations, the control treatment (No exposure) had the highest chlorophyll A, B and A+ B concentration than the other UV-C exposure periods and the most effective exposure period was found at 120 minutes. The Chlorophyll ratio was varied among the tree species. Numerous studies have shown that impact of UV-B radiation on plant development can be miscellaneous. Exceeding ambient radiation intensity caused damage or negative impact on different plant cell, membrane, photosynthesis system, hormones, but no studies were concerned with the UV-C and their impact on plant development and heath status. Further studies are required to understand the mechanism of the UV-C radiation on the trees growth, trees development and trees heath.

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الملخص العربي

تأثير الأشعة الفوق بنفسجية- سى على أنبات البذور و تركيز الكلوروفيل فى بعض أنواع الأشجار الخشبية النامية فى المملكة العربية السعودية

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النقص المستمر لطبقة الأزون في طبقات الجو العليا أدى إلى حدوث زيادة شديدة في الأشعة فوق البنفسجية الواصلة للأرض في العشرين عام الأخيرة من القرن العشرين. أجريت تلك الدراسة في معمل الغابات و البيت المحمى لقسم الإنتاج النباتي بكلية علوم الأغذية والزراعة – جامعة الملك سعود في الفترة من أكتوبر 2008 و حتى مايو 2009 في تجربتين تكراريتين بهدف دراسة تأثير الأشعة فوق البنفسجية - سى على أنبات البذور و تركيز الكلوروفيل لأربعة أنواع شجرية نامية في محطة الأبحاث الزراعية بديراب جنوب مدينة الرياض و كانت الأنواع المدروسة هى أكاسيا أمبليسبس و الطلح جيراردى و الكازوارينا البيضاء و كافور انترتكستا. أوضحت النتائج هناك تأثير معنوي واضح للأشعة فوق البنفسجية- سى على أنبات البذور و تركيز الكلوروفيل في الأنواع الشجرية المدروسة، حيث وجد أنه بزيادة فترة التعرض للأشعة يؤدى إلى حدوث نقص واضح في تركيز كلوروفيل أ و كلوروفيل ب و كلوروفيل أ + ب. بالنسبة لإنبات البذور لوحظ تأثرها الواضح لفترة التعرض لأشعة حيث بزيادة فترة التعرض تنخفض نسبة الإنبات. أكثر فترات التعرض للأشعة تأثيرا على نسبة الإنبات كانت التعرض لمدة 72 ساعة متواصلة بينما كانت 120 دقيقة أكثر تأثيرا على تركيز الكلوروفيل أ و ب و أ + ب للأنواع محل الدراسة في التجربتين. أظهرت الدراسة اختلاف في معدل الكلوروفيل بين الأنواع الشجرية في التجربتين نتيجة للتعرض لفترات الإشعاع بالأشعة فوق البنفسجية – سى و كانت شجرة الطلح النجدى أعلى الأنواع الشجرية المدروسة في معدل الكلوروفيل في التجربتين. و أن أكثر فترة تعرض أعطت معدل كلوروفيل مرتفع نوعا بالمقارنة بأنواع الأخرى هي 30 دقيقة بينما أقل معدل للكلوروفيل كان عند معاملة الكنترول (بدون تعرض) في التجربة الأولى. العكس كان في معاملة الكنترول بينما كانت أعلى معدل للكلوروفيل عند التعرض لمدة 120 دقيقة في التجربة الثانية. من النتائج المتحصل عليها من الدراسة نجد أن شجرة الأكاسيا أمبيلسبس كانت أكثر الأنواع الشجرية المدروسة مقاومة للتعرض للأشعة فوق البنفسجية- سى ، حيث أعطت أعلى نسبة أنبات و تركيز للكلوروفيل أ و كلوروفيل ب و كلوروفيل أ + ب، مقارنة بالأنواع الشجرية المدروسة بينما أكثر الأنواع حساسية للتعرض للأشعة فوق البنفسجية- سى كانت الكافور انترتكستا. و بالتالي توصى الدراسة بالاهتمام بأجراء مزيد من الدراسات في هذا المجال و فهم ميكانيكية تأثير الأشعة فوق البنفسجية على فسيولوجيا و مورفولوجيا الأشجار الخشبية.