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Influence of Seed pre-treatment by UV-A and UV-C radiation on germination and growth of Mung beans

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Abstract
The consequence of pre-treatment of UV-A (366 nm) and UV-C (254 nm) radiation on seed germination and growth of *Vigna radiata* was investigated at three different exposure period (2, 4 and 6 hours). Supplementation of UV-A enhanced the germination rate, specific leaf area, root and shoot length and dry weight than the UV-C supplemented plants.

Keywords: Dry mass, Root length, Seed Germination, Shoot length, Specific leaf area, UV-A, UV-C, *Vigna radiata.*

1. INTRODUCTION

Release of halogenated hydrocarbons (chlorofluorocarbons) and many trace gases (methane and Nitrous oxide) in the atmosphere due to numerous anthropogenic human activities resulting in the depletion of the stratospheric ozone layer [1]. Stratospheric ozone plays a very important role in defending the earth's surface from ultraviolet radiation [2]. Depletion of Stratospheric ozone is expected to increase the amount of solar ultraviolet radiation reaching the surface of earth which can damage the biological ecosystems [3]. A 10% depletion in stratospheric ozone corresponds to a 20% increase in the capability of biologically damaging UV-B, which is likely to enhance in future, if ozone destruction is not checked [4]. The UV spectrum is usually separated into three regions: the UV-C region (220- 280 nm), the UV-B region (280 - 320 nm) and the UV-A region (320 - 400 nm). UV-B radiation is the most active constituent of sunlight reaching the earth's surface as compare to UV-A[5].

Enhance in the solar UV radiation reaching the biosphere may have several effects on global plants by increasing the biological damage[6]. UV radiation induced alteration in photosynthesis, cell division and other life processes of direct importance to growth and development such as alterations in plant hormones and nucleic acids [7]. Although defensive and repair mechanisms exist to counteract the effects of increased UV radiation[8]. According to another report morphological, physiological and biochemical significance of UV radiation on vast varieties of plants system have been observed [9]. Several researchers reported the potential effects of UV-B on vegetative growth and photosynthetic activities of higher plants[10].

By means of this background, we hypothesize that seed pre-treatment by UV radiation boosted the rate of seed germination and improve vegetative growth. The present study was designed to assess the effects of pre-treatment of two UV regions i.e. UV-A (366 nm) and UV-C (254 nm) radiation on the Specific leaf area, root and shoot length and dry weight and percent germination of *Vigna radiata*, a leguminous plant.

2. EXPERIMENTAL

Mung bean (*Vigna radiata*) seeds were obtained locally. Seeds were alienated into small batches, which were stored in closed glass bottle in refrigerator at 4°C. For irradiation seeds samples were removed from the refrigerator and the seeds, still in their airtight glass bottles, were kept closed overnight to equilibrate with laboratory temperatures before irradiation. Then these seed were irradiated by UV using 022.9064 The CAMAG UV cabinet ll which comprised of the CAMAG universal UV lamp having dual wavelength 254nm (short wave) and 366nm (long wave), two light tubes 8 watt each. Seeds were exposed for 2, 4 and 6 hours at both wavelengths and non treated seeds were serving as control.

Twenty one Petri dishes of 9cm diameter each were containing two filter papers (Whatman no. 1 of 90mm thickness). The top of all Petri dishes were removed after which the dishes were divided into seven groups of three Petri dishes. Twenty seeds of each treatment (4 rows of 5 seeds) were placed in the wet filter paper. The distance between adjacent seeds was sufficient (five times greater than diameter of seeds). Petri dishes were kept in germinator at 23/18°C during course of experiment; the filter papers were humidified regularly with distilled water. The germination of seeds was followed for seven days. Number of germinated seeds was recorded after 1, 2, 3, 4, 5, 6 and 7 days and germination percentage was recorded. After germination seven days old seedling were transplanted in plastic pots (12cm diameter and 15cm height) contains 1.5 Kg of soil which was provided with 50mg of NPK fertilizer. Different parameters of growth like shoot and root length, dry mass and specific leaf area were calculating after 10 days interval up to 60 days. Shoot and root length and specific leaf area were carefully calculated and observations were recorded in Cm and Cm^{-2}.gm respectively. Dry mass (gm) was determined after drying in an oven at 70°C for 48 hours.

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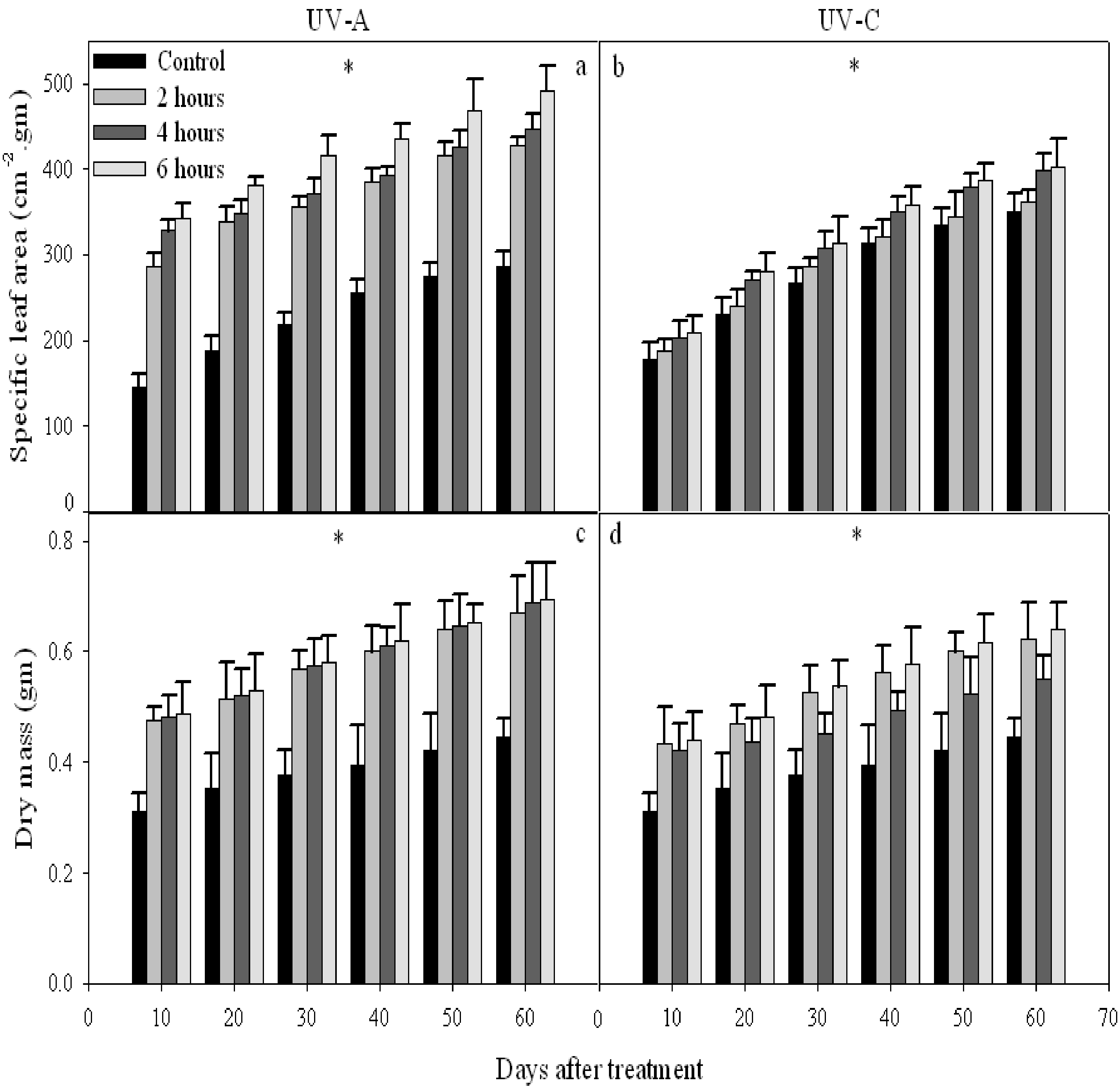

Fig-1: Effect of UV-A and UV-C enhanced radiation on specific leaf area (a, b) and dry mass (c, d) of *Vigna radiate* at different treatment period. Significant result denoted by asterists (*, P < 0.05)

2.1 *Statistical Analysis*

The data for growth parameters of Mung bean exposed to UV-A (366 nm) and UV-C (254 nm) for 2, 4 and 6 hours were analyzed using "COSTAT" statistical program by two-way analysis of variance (ANOVA) to compare the means of different treatment. "SIGMA PLOT" program was used for graphical representation of data.

3. RESULTS AND DISCUSSION

Germination test of UV irradiated seeds revealed that mean germination rate was increased in UV-A (366 nm) and UV-C (254 nm) irradiated seeds as compare to control (Table 1). Result obtain for final germination percentage was statistically significant (P< 0.05). The present investigation showed that UV irradiation causes more rapid germination of seeds. This is probably due to the fact that UV photons (<400nm) are more energetic than visible light photons (>400nm) and, hence have a stronger effect on the surface of the plant cell [11]. According to another report stronger effect of UV on plant surface cell causes the ultimate break down of seed coating allowing germination to occur [12].

The effect of UV-A (366 nm) and UV-C (254 nm) radiation on dry mass production and specific leaf area parameters was showed in (Fig. 1). Both total dry mass production and specific leaf area of plant was showed significant ($P< 0.05$) increased, which was more pronounced in UV-A treatment as compare to UV-C treatment. Similar trend was observed for shoot and root length (Fig. 2). Positive effect of UV radiation on growth parameters is substantiation for its regulatory role in photomorphogenesis[13]. Lingakumar & Kulandaivelu have reported that growth has also been promoted by the supplementation of UV in *Cymopsis* seedlings[14]. Enhanced UV radiation promotes vegetative growth possibly via the stimulation of Indole acetic acid (IAA) biosynthesis[13]. Middleton & Teramura have also observed that the combination of visible light and UV, at a particular ratio, is highly suitable for enhanced seedling development[15].

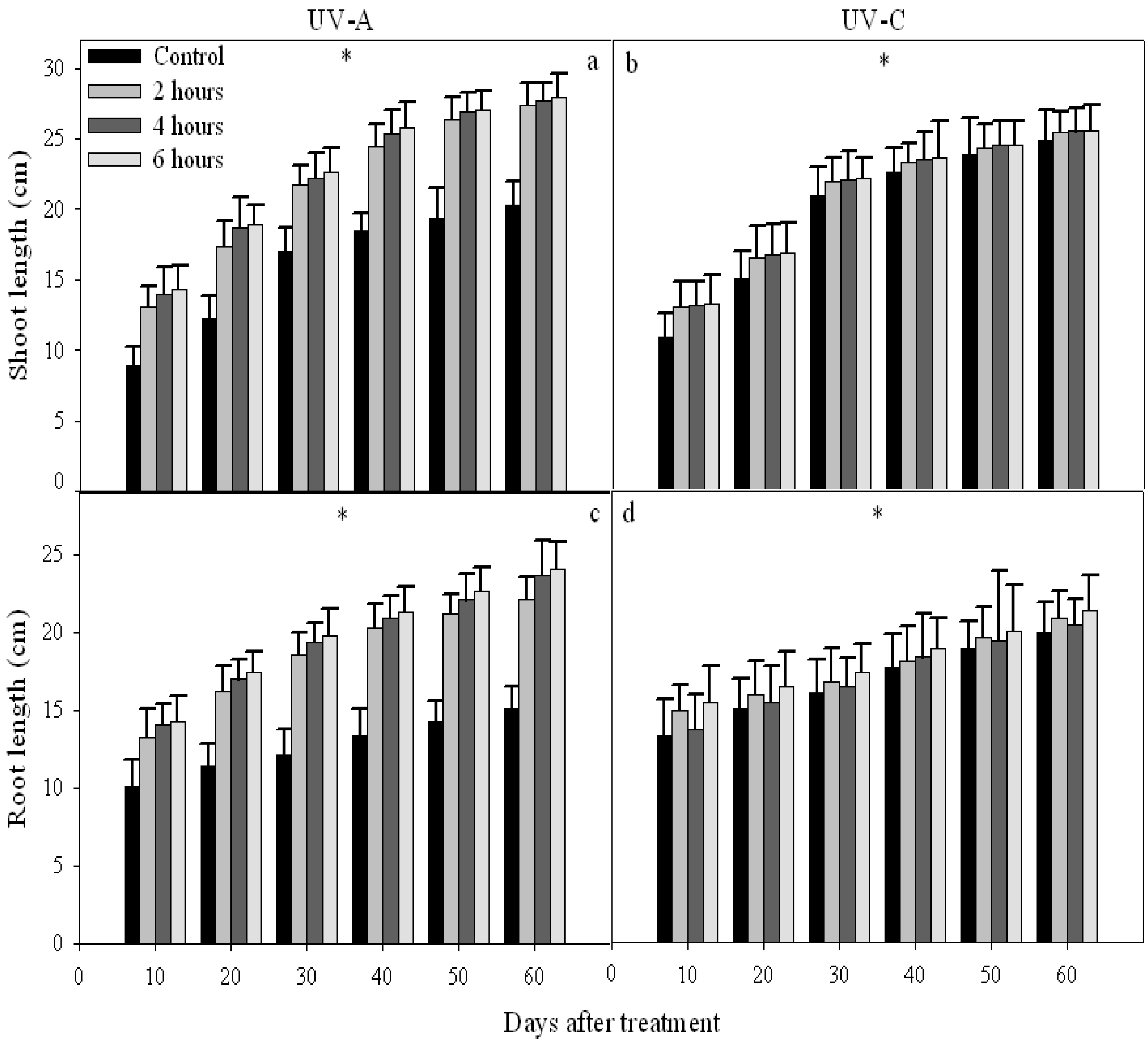

Fig-2: Effect of UV-A and UV-C enhanced radiation on shoot length (a, b) and root length (c, d) of Vigna radiate at different treatment period. Significant result denoted by asterisks (*, $P < 0.05$)

4. CONCLUSION

The present investigation showed that pre-treatment of seed with UV-A (366 nm) radiation improves the germination rate, specific leaf area, dry mass, root and shoot length as compare to UV-C (254 nm) exposed seed.

Table-1: Effect of UV-A and UV-C enhanced radiation on germination rate of *Vigna radiata* at different treatment period.

Treatment period (Hours)	**UV-A**		**UV-C**	
	No. of germinated seed	Germination rate (%)	No. of germinated seed	Germination rate (%)
Control	16	80	16	80
2	18	90	18	90
4	19	95	17	85
6	20	100	17	85

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