Short Communication

Effect of UV-B radiation on growth and yield of *Capsicum annum* L.

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ABSTRACT

Human life is majorly dependent on plants and plants require sunlight for photosynthesis which regulates proper growth and development. Any change or effect to these plants can cause heavy lose to their market value as well as can affect the human body. Moreover, it has been recognized that UV-B radiation (280–315 nm) when induced to plants can cause phenolic compound accumulation, flavonoid destruction and even can damage the DNA structure of the plants. The aim of the present study was to evaluate the effect of UV-B exposure on *Capsicum annuum* plant growth and yield. The UV-B induced a reduction in stem length, stem dry weight and number of floral, leave size. The largest reduction in these variables was observed when combining UV-B and drought. UV-B treated well-watered plants displayed fructification approximately 1 week earlier than non-UV-B-treated controls. The control plants show proper growth with fruits and flower.

Keywords: UV-B radiation, *Capsicum annuum,* Ultraviolet rays, growth reduction.

1. INTRODUCTION

Plants are basic unit of any life on earth and they require sunlight for photosynthesis which regulates proper growth and development. The photosynthetically solar radiation which reaches the Earth surface is majorly categorised into three spectral regions with different wavelengths, out of which ultraviolet-B (UV-B) radiations range from 290 nm to 315 nm. When the UV-B light passes through the stratospheric ozone layer their potential is attenuated, avoiding their penetration on earth's atmosphere. [1,2]. But gradual increase in human activities over few decades, created major havoc leading to depletion of about 40% global ozone [3], wherein allowing UV-B radiation to penetrate through stratospheric ozone to reach the Earth [3–7]. The terrestrial life, UV radiation and ozone depletion have significant relationship with oxygenic photosynthesis as it appears that plants have one highly UV-sensitive site with water-oxidizing machinery that helps in the formation of the oxygenic atmosphere and ozone shield [4]. When plants exposed to UV-B radiation, they show various response and can have distinct photomorphogenic changes. The plants when get ample of exposure by UV- B radiations they

mediate biochemical pathways, photosynthesis, plant growth as their photoreceptors initiate morphogenetic changes and alter many essential processes of development and can even cause DNA damage [6]. The effect of UV-B radiation can be rapid, reversible, involves signal transduction and exhibits maximal effectiveness [4]. However, different plant species like rice, cotton, cucumber [7-9], etc. show variation in morphological sensitivity to UV-B radiation [5]. A recent study on *C. annuum* using UV-A and UV-B radiation (280 and 400 nm) in protected film showed no significant changes in growth, morphology and leaf transmittance [6]. Chilli peppers are found throughout the world and is economically important crop, mostly exploited in agriculture, pharmaceutical and medicinal industry since ages. They are even extensively used in food industry around the globe. This work aimed at evaluating the effect of UV-B radiation on chilli pepper plant morphology, as a result of ozone depletion.

2. METHOD AND MATERIAL

2.1. Plant material and growth conditions

Experiments were conducted at university campus in sunlight and controlled environment facility known as artificial phytotron (72° 51' 1020'' E and 19° 4' 5632'' N) in Mumbai, India. Total 10 Plant sapling of sannam S4 type variety, with height ranging from 10cm-16cm were collected from local nursery and sown in the well-drained black soil bins. Sapling were properly irrigated and kept under sunlight for 6 days. After six days five alternate bins out of ten were transferred to the phytotron units and other five were kept under sunlight, to observe as control for collecting growth data until the end of the experiment (95 DAE). The saplings were well-irrigated manually for maintaining the moisture of the soil. The phytotron units consisted of a 2 UV-B-emitting fluorescent lamps (Philips TL40/12). The exposure UV-B radiation was done daily for 9 hours during daytime with temperature maintained between 23-28 ºC.

2.2. UV-B irradiation protocol

Since the beginning at emergence and continuing until harvest, the biologically effective UV-B radiation were imposed in a total daily flux of 8 kJ m^{-2} d^{-1} (ambient) depletion of stratospheric ozone. The UV-B radiation from two UV-B lamps (Philips TL40/12) were arranged on a rack perpendicular to the bins was delivered for 9 h from 0800 to 1700 h during daytime with temperature maintained between 23-28ºC. The intensity of UV-B radiation was kept constant during the treatment and the saplings were checked daily. Rack height was adjusted, as needed, to maintain the respective UV-B radiation levels. Lamps were always at a height of 0.3 m above the canopy.

2.3. Growth measurement

Plant height, main stem node number, and internode and branch lengths (sum of individual branch lengths) were recorded on ten plants (treated and untreated) in each treatment at 95 DAE. Plant growth, Branch number, number of fruits, Lengths of leaves (maximum measurable length), nodes and internodes were measured for each treatment.

2.4. Statistical analysis

Statistical analysis was carried out using SPSS version 16 for Windows 10. One-way ANOVA was used to determine differences between the treatments for the parameters presented in the study.

3. RESULTS AND DISCUSSION

The exposure treatment of UV-B radiation (8 kJ m–2 d–1) to chilli plants after 95 (DAE) led to significant reduction in plant height from 38.1 to 32.6 cm (average height 35.4 ± 2.05) as compared with that of control plants 76.2cm to 71.1cm (average height 72.9 ± 2.1) (Figure 1). There was significant difference in main stem node number among the treatments. Internode lengths of plants exposed to UV-B treatments were severely shortened (4.03 ± 0.09) than control (7.85 ± 0.38) (figure 2). Total branch length differed as UV-B radiation treatments plants showed lateral expansion more than control plant. UV-B treatment changed leaf texture which leads to thinness of leaves whereas the plants in control had significantly thick. The leaf area of the fully expanded leaf from individual plant under UV-B radiation was 11 cm^2 which comparatively reduced from that of control plant (28 cm^2) (figure 3). Few of the leaves in the UV-B treatment developed chlorotic patches and some even turned into necrotic patches

Figure 1: Length comparison of treated and untreated plant

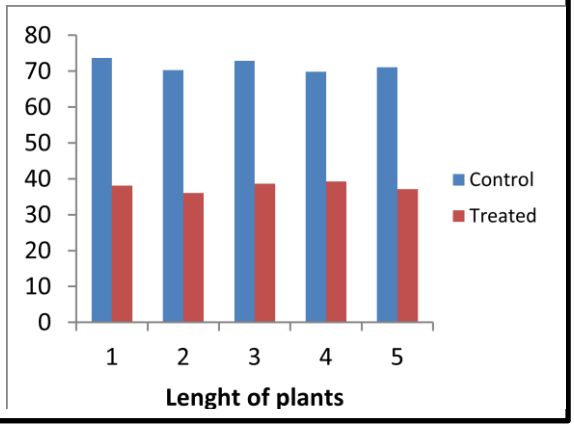
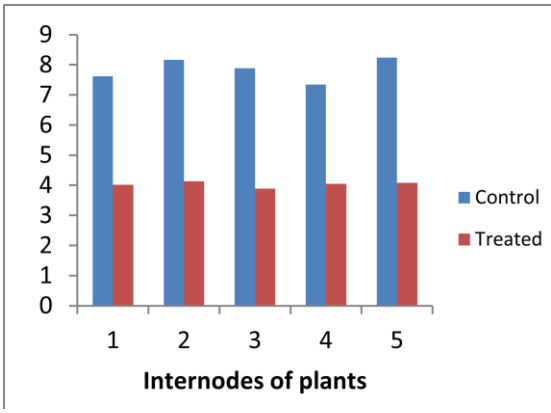


Figure 2: Internode comparison of treated and untreated plant



In several studies it is observed that UV-B-induced alterations in morphology are consistently observed in different plants. The morphological alterations in exposed plants involve both the inhibition and stimulation of growth in vegetative organs of that respective plant. These can involve reduction in photosynthetic carbon assimilation [10], chlorophyll fluorescence or total biomass production [11] or shifts in allocation UV-B acclimation [12]. The plants delay cell division mechanism under UV-B radiation leading to growth reduction and thus, reduce the impact of UV-B effects on DNA integrity [13]. The reduction in growth of leaves and stems may be due to from partial inhibition of photosynthesis on general growth capacity resulting forms of UV radiation damage. Plants when exposed at stressed conditions with UV-B radiation, they resulted in morphological changes, reductions in photosynthesis, total plant production, total biomass and even secondary components [7, 14]. Contrary to out result, few studies even suggest that, specific UV-B photoreceptor can be

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Figure 1: A) Plant with reduction in growth and loss of chlorophyll: B) Plant with normal growth (control) after 66 (DAE)

involved in mediating the elongation responses of exposed plant [15]. But it was not observed in most cases. Thus, having similarity with other species studies, our plant also resulted displaying reduction in plant overall morphological growth. Thus, in total, UV-B radiation induces selective regulation of development, morphology and growth in chilli pepper, similarly to previous results with chilli pepper and other plant species [7, 16].

4. CONCLUSION

Almost all plants which are exposed to UV-B radiation have shown reduced growth when compared with non-exposed/control plants. Our study shows that chilli plants display a clear reduction in plants morphological growth in UV-B exposure. A more detailed study using several UV-B doses, exposure times, and probably during different phonological stages of chilli development, need to be conducted in order to exhaustively evaluate increased UV-induced drought tolerance in this crop. This also includes a larger transcriptome study.

5. CONFLICT OF INTEREST

NA

6. SOURCE/S OF FUNDING

No source of funding

7. REFERENCES

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