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SYNERGISTIC EFFECT OF CADMIUM IN COMBINATION WITH UV-B RADIATIONS IN PS II PHOTOCHEMISTRY OF THE CYANOBACTERIUM *SPIRULINA PLATENSIS*

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ABSTRACT
In this present investigation an attempt has been made to study the synergistic effect of UV-B radiation (2-6Wm^{-2}) in combination with cadmium chloride (0.2-0.6mM) on photosystem II catalyzed electron transport in cyanobacterium *Spirulina platensis*. UV-B radiation alone caused 52% inhibition at 4 Wm^{-2}. Similarly when cadmium is applied 61% loss in the Hill reaction was noticed at 0.6 mM concentration. When both the stresses are applied in combination there was 84% loss in the PS II catalyzed electron transport .The reason for the loss of PS II catalyzed electron transport could be due to alterations at water oxidation complex .Thus when cadmium treated cells are exposed to UV-B the effect on PS II photochemistry is additive in the cyanobacterium *Spirulina platensis*.

INTRODUCTION

Stress is a unfavorable condition where several environmental factors work together either alone (or) in combination and influence the several physiological activities in plants (Murthy and Rajagopal, 1995; Mohanty and Mohanty, 1988). The level of alterations in plant physiological activities depends on intensity, duration and its combination with others. Photosynthesis is one of the physiological process gets affected by the stress factors (Lichtenthaller,1996) up to now the studies were being made in higher plants and some selective cyanobacterial cells. Therefore in this investigation an attempt has been made to study the effect UV-B radiation in combination with cadmium stress on primary reactions of photosynthesis in the economically important cyanobacterium *Spirulina platensis*.

MATERIALS AND METHODS

Spirulina platensis was grown in Zarrouk's medium (Zarrouk, 1966) at 25 ± 2°C under continuous illumination of white light (15 Wm^{-2}). The cells were exposed to different concentrations cadmium chloride ranging from 0.2 to 0.6 mM in dark for 1hr before measuring the photosynthetic parameters. Similarly cells were exposed to individually to UV-B radiation (2-6 Wm^{-2}) for 30 min under continuous stirring. To study the synergistic effect of UV-B radiated cells were initially treated with $cdCl_2$ then they were exposed to UV-B radiation for 30 min. The stress responses in treated cells are measured in terms of PS-II catalyzed electron transport using oxygen electrode by following the procedure of Murthy *et al*., (1989). Whole chain electron transport assay mixture contained reaction buffer (25mM-HEPES –NaOH, (pH - 7.5), 20 mM NaCl), 0.5mM, 1mM sodium azide and the intact cells equivalent to 12 to 15 μg Chl a. The reaction mixture for the assay of PS II contained reaction buffer, 0.5mM freshly prepared PBQ and intact cells .The estimation of Chl *a* has been made by following the method of Mackinney (1941).

RESULTS AND DISCUSSION

After giving the UV-B treatment (2-6 Wm^{-2}) for 30 min decrease in the whole chain electron transport and 44% inhibition was noticed at 4 Wm^{-2} UV-B treatment similarly cadmium treatment caused dose dependent inhibition whole chain electron transport and 55% inhibition was observed with 0.6 mM of cadmium chloride treatment (Table 1). The inhibition in whole chain electron transport could be either due to inhibition at PS II or at PS I. But the above two stress are applied together the inhibition was more and it is around 71% (Table 3). This additive effect in whole chain electron transport could be due to combination of UV-B radiation stress with cadmium (Table 5). To verify whether PS II electron transport is target for UV-B or / cadmium an attempt has been made to measure the PS II catalyzed electron transport PBQ is being lipophilic in nature, it enters easily into the intact cells of *Spirulina*. Control cells exhibited a high rate of oxygen evolution due to PS II activity (235 μ mole O_2 evolved mg $Chl^{-1}h^{-1}$) (Table 2). The treatment of UV-B radiation brought 25% inhibition loss in pBQ supported Hill activity. At 6wm^{-2} of UV-B treatment, 74 % was noticed. These results are in agreement with the observa-

Table: 1 Effect of UV-B radiation on whole chain electron transport assay ($H_2O \rightarrow MV$) in the cyanobacterium, *Spirulina platensis*

UV-B radiation Wm^{-2}	Whole chain electron transport activity ($H_2O \rightarrow MV$) μ moles of O_2 consumed $mg^{-1}Chl\ h^{-1}$	Percentage loss
Control	199 ± 15	0
2	157 ± 11	21
4	111 ± 9	44
6	64 ± 4	68

Table: 2 Effect of UV-B radiation on photosystem II electron transport activity ($H_2O \rightarrow pBQ$) in the cyanobacterium, *S. platensis*

UV-B radiation Wm^{-2}	PS II Catalyzed electron transport activity $H_2O \rightarrow PBQ$ μ moles of O_2 evolved mg $mg^{-1}Chl\ h^{-1}$	Percentage loss
Control	235 ± 18	0
2	181 ± 15	23
4	113 ± 9	52
6	61 ± 4	74

Table: 3 Effect of different concentrations of cadmium on whole chain electron transport assay ($H_2O \rightarrow MV$) in the cyanobacterium, *Spirulina platensis*

Concentration of $CdCl_2$,mM	Whole chain electron transport activity $H_2O \rightarrow MV$ μ moles of O_2 consumed $mg^{-1}Chl\ h^{-1}$	Percentage loss
Control	206 ± 16	0
0.2	169 ± 12	18
0.4	150 ± 11	27
0.6	93 ± 7	55

Table: 4 Effect of different concentrations of cadmium on photosystem II Catalyzed electron transport activity ($H_2O \rightarrow pBQ$) in the cyanobacterium, *Spirulina platensis*

Concentration of $CdCl_2$,mM	PS II catalyzed electron transport activity $H_2O \rightarrow pBQ$ μ moles of O_2 evolved $mg^{-1}Chl\ h^{-1}$	Percentage loss
Control	229 ± 19	0
0.2	179 ± 16	18
0.4	148 ± 12	27
0.6	89 ± 7	55

Table: 5 Effect of combination of cadmium and UV-B radiation on whole chain electron assay ($H_2O \rightarrow MV$) in the cyanobacterium, *Spirulina platensis*

UV-B + $CdCl_2$	Whole chain electron transport activity $H_2O \rightarrow MV$ μ moles of O_2 consumed $mg^{-1}Chl\ h^{-1}$	Percentage loss
Control	210 ± 18	0
$4Wm^{-2}$ + 0.4mM		71 ± 5 66
$4Wm^{-2}$ + 0.6mM		61 ± 6 71

tions of Iwanzik *et al.,* (1983) who showed that changes in water oxidation complex are responsible for the altered PS II activity photochemistry. The reason for the inhibition of PS II activity could be alterations at the level of light harvesting pigment complex. It was observed that there is a 35% loss activity at 0.4 mM conc. and further increase in the dose to 0.6 mM inhibition (Table 4). Similar reports were made by Krupa, (1988) in *Brassica napus* plants under cadmium stress indicating the heavy metal mediated changes in LHC II and lipid peroxidation of thylakoid membranes. But the combined stress induced more inhibition and it is additive in nature. Therefore an attempt a has been made to study the effect of UV-B with cadmium on PS II electron transport .It showed 84% inhibition with 0.6mM concentrations. Thus UV-B when applied along with cadmium shows the additive effect in PS II mediated photosynthetic electron transport (Table 6).

Table: 6 Effect of combination of cadmium and UV-B radiation on photosystem II catalyzed electron transport activity ($H_2O \rightarrow pBQ$) in the cyanobacterium, *Spirulina platensis*

UV-B + $CdCl_2$	PS II Catlyzed electron transport activity $H_2O \rightarrow pBQ$ μ moles of O_2 evolved $mg^{-1}Chl\ h^{-1}$	Percentage loss
Control	240 ± 21	0
$4Wm^{-2}$ + 0.4mM	74 ± 6	69
$4Wm^{-2}$ + 0.6mM	63 ± 7	84

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