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Research Article

EFFECT OF LEAD (Pb) AND IRON (Fe) ON CHLOROPHYLL AND CAROTENOID IN *EICHHORNIA CRASSIPES* (MART.) SOLMS (WATER HYACHINTH)

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ABSTRACT

Anthropogenic activities like mining, ultimate disposal of treated and untreated waste effluents containing toxic metals as well as metal chelates from different industries, e.g. tannery, steel plants, battery industries, thermal power plants etc. and also the indiscriminate use of heavy metal containing fertilizers and pesticides in agriculture resulted in deterioration of water quality rendering serious environmental problems posing threat on human beings and sustaining aquatic biodiversity. This study deals the effect of different dose concentration (0.5 ppm, 1.0ppm, 1.5ppm and 2.0ppm) of Lead (Pb) and Iron (Fe) on chlorophyll and carotenoid content (mg/kg FW) of *Eichhornia crassipes* in three consecutive years 2015, 2016 and 2017 in 7days, 14days, 21days and 28days. It was observed that when the dose concentration of Lead or Iron and observation days were increases, the Chl 'a' , Chl 'b' and carotenoid contents in *Eichhornia crassipes* were decreases with comparison to control and observation day's was also higher in 7days in comparison to 14days, 21days and 28days respectively. High concentration of Pb inhibits chlorophyll synthesis by impaired uptake of other essential ions by plants like Mg and Fe or due to increased chlorophyllase activity.

INTRODUCTION

Beside the natural activities, almost all human activities also have potential contribution to produce heavy metals as side effects. Migration of these contaminants into non-contaminated areas as dust or leachates through the soil and spreading of heavy metals containing sewage sludge are a few examples of events contributing towards contamination of the ecosystems (Bieby Voijant Tangahu *et al.*, 2011).

Lead is one of the most abundant toxic metals in the earth crust. Elevated Pb in soils may compromise soil productivity and even a very low concentration can inhibit some vital plant processes, such as photosynthesis, mitosis and water absorption with toxic symptoms of dark leaves, stunted foliage (Patra *et. al.*, 2004; Singh *et. al.*, 2011). Lead (Pb) is one of the prominent examples for anthropogenic environmental metal pollution that originates from various activities including mining and smelting of lead-ores, burning of coal, effluents from storage battery industries, automobile exhausts, metal planting and finishing operations, fertilizers, pesticides and from additives in pigments and gasoline (Sharma and Dubey, 2005; Abdul Ghani, 2010).

Although several adverse effects of the toxic metals have been known for a long time, exposure to heavy metals continues, and is even increasing in some parts of the world, in particular in less developed countries. Heavy metal pollution is also a multi-element problem in many areas (An *et al.*, 2004). Lead (Pb) and Iron (Fe) were chosen for this investigation since they are common toxic metals found in waste water or polluted water.

MATERIALS AND METHODS

Chlorophyll estimation

The plants were harvested after 7days, 14days, 21days and 28days for estimation of Chlorophyll (Chl 'a', Chl 'b' and Total Chl) and carotenoids. Chlorophyll content was determined through Arnon (1949) method by using UV Visible Spectrophotometer (Elico, SL 160). Extracted fresh leaves (100mg) were crushed in 5 ml of (80%) chilled acetone. Extract was centrifuged at 10,000 rpm for 10 minutes and absorbance in supernatant was read at 663 and 645. Absorbance at 750 nm was also recorded for rectifying any error. Chlorophyll a, b and total chlorophyll contents were calculated in mg/kg FW by the formula as given below.

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$$\text{Chlorophyll (a)} = \frac{12.7\ (A_{663}) - 2.63\ (A_{645}) \times V}{1000 \times W}$$

$$\text{Chlorophyll (b)} = \frac{22.9\ (A_{645}) - 4.68\ (A_{663}) \times V}{1000 \times W}$$

$$\text{Total Chlorophyll} = \frac{20.2\ (A_{645}) - 8.02\ (A_{663}) \times V}{1000 \times W}$$

Carotenoid estimation

Known amounts of leaves were extracted in 80% chilled acetone and absorbance was read on UV Visible Spectrophotometer (Elico, SL 160) at wavelength 480 and 510 nm. Amount of carotenoid was calculated in mg/kg FW by the formula given earlier (Duxbury and Yentsch, 1956).

$$\text{Caroteinoid} = \frac{7.6\ (A_{480}) - 1.49\ (A_{510}) \times V}{D \times 1000 \times W}$$

Where A_{480} and A_{510} = absorption at these wavelength

V = Final extract volume ml (5.0)
W= Weight of sample in g (0.1)
D= Length of light path (1)

Statistical Analysis

The data obtained from various observations of Chlorophyll (Chl a, Chl b and Total Chl.) and carotenoids was subjected to statistical analysis (ANOVA Two way) using with the help of IRRISTAT for Windows version 4.0.2.0. Microsoft excels for Standard error (SE). The level of significance was used as * P<0.05 and ** P<0.01.

RESULTS AND DISCUSSION

This study deals the effect of different dose concentration (0.5 ppm, 1.0ppm, 1.5ppm and 2.0ppm) of Lead (Pb) and Iron (Fe) on chlorophyll and carotenoid content (mg/kg FW) of *Eichhornia crassipes* in three consecutive years 2015, 2016 and 2017 in 7days, 14days, 21days and 28days. The data have been presented in the Tables (1 to 6) and Figure (1 to 6). The effect of different concentration of Lead in 2013, Chl 'a' was higher in the dose of 0.5ppm (8.54mg/kg FW). After that it was decreases in 1.0ppm, 1.5ppm and 2.0ppm respectively. In the respect of observation days it was higher in 7days followed by 14days, 21days and 28days respectively (Table-1). Similar trends were observed in the case of different dose of Iron (Fe). Chl 'a' was also recorded higher in 0.5ppm dose (8.52mg/kg FW) in 7days (Table-2).

In the year 2015, the Chl 'b' was affected after different dose concentration of Lead (Pb) and Iron (Fe). It was higher in 0.5ppm dose (2.42mg/kg FW) of Lead (Pb) followed by 1.0ppm, 1.5ppm, 2.0ppm respectively and in view of different days observation it was maximum in 7days followed by 14days, 21days and 28days respectively (Table-1). After the different dose concentration of Iron (Fe), Chl 'b' was also maximum in 0.5ppm and lower in 2.0ppm and in the similar trend it was higher in 7days followed by 14days, 21days and 28days respectively (Table-2).

After the effect of different dose concentration of Lead (Pb) on Carotenoid content was higher in 0.5ppm (10.96mg/kg FW) followed by 1.0ppm, 1.5ppm and 2.0ppm respectively in 2015.

Table 1 Effect of different concentration of Lead (Pb) on Chlorophyll and Carotenoid content (mg/kg FW) in *Eichhornia crassipes* (2015)

Days►	7days				14 days				21 days				28 days			
Dose Concentration (ppm)▼	Chl a	Chl b	Total Chl	Carotenoids	Chl a	Chl b	Total Chl	Carotenoids	Chl a	Chl b	Total Chl	Carotenoids	Chl a	Chl b	Total Chl	Carotenoids
Control	8.56 ± 0.017	2.45 ± 0.057	11.01 ± 0.026	6.76 ± 0.017	8.52 ± 0.045	2.40 ± 0.015	10.92 ± 0.028	6.68 ± 0.045	8.45 ± 0.032	2.38 ± 0.016	10.83 ± 0.032	6.60 ± 0.018	8.40 ± 0.057	2.28 ± 0.025	10.68 ± 0.027	6.52 ± 0.014
0.5	8.54 ± 0.034	2.42 ± 0.038	10.96 ± 0.048	6.70 ± 0.045	8.50 ± 0.038	2.34 ± 0.026	10.84 ± 0.016	6.56 ± 0.012	8.32 ± 0.011	2.26 ± 0.021	10.58 ± 0.043	6.52 ± 0.032	8.32 ± 0.034	2.12 ± 0.027	10.44 ± 0.045	6.40 ± 0.026
1	8.48 ± 0.054	2.37 ± 0.029	10.85 ± 0.016	6.62 ± 0.035	8.39 ± 0.027	2.28 ± 0.037	10.67 ± 0.065	6.48 ± 0.032	8.24 ± 0.042	2.10 ± 0.042	10.34 ± 0.015	6.40 ± 0.054	8.17 ± 0.011	2.05 ± 0.032	10.22 ± 0.062	6.26 ± 0.046
1.5	8.45 ± 0.038	2.37 ± 0.054	10.82 ± 0.032	6.50 ± 0.053	8.28 ± 0.018	2.25 ± 0.013	10.53 ± 0.052	6.32 ± 0.045	8.10 ± 0.015	1.94 ± 0.056	10.04 ± 0.025	6.26 ± 0.028	8.05 ± 0.016	1.92 ± 0.012	9.97 ± 0.053	6.12 ± 0.058
2.0	8.40 ± 0.021	2.30 ± 0.036	10.70 ± 0.016	6.48 ± 0.028	8.19 ± 0.029	2.25 ± 0.018	10.44 ± 0.018	6.30 ± 0.052	8.02 ± 0.043	1.90 ± 0.048	9.92 ± 0.043	6.10 ± 0.017	7.67 ± 0.014	1.84 ± 0.026	9.51 ± 0.011	5.78 ± 0.042

Table 2 Effect of different concentration of Iron (Fe) on Chlorophyll and Carotenoid content (mg/kg FW) in *Eichhornia crassipes* (2015)

Days►	7days				14 days				21 days				28 days			
Dose Concentration (ppm)▼	Chl a	Chl b	Total Chl	Carotenoids	Chl a	Chl b	Total Chl	Carotenoids	Chl a	Chl b	Total Chl	Carotenoids	Chl a	Chl b	Total Chl	Carotenoids
Control	8.56 ± 0.012	2.45 ± 0.032	11.01 ± 0.011	6.76 ± 0.034	8.52 ± 0.012	2.40 ± 0.026	10.92 ± 0.016	6.68 ± 0.022	8.45 ± 0.013	2.38 ± 0.045	10.83 ± 0.052	6.60 ± 0.018	8.40 ± 0.032	2.28 ± 0.058	10.68 ± 0.026	6.52 ± 0.018
0.5	8.52 ± 0.015	2.43 ± 0.045	10.95 ± 0.032	6.72 ± 0.057	8.40 ± 0.016	2.32 ± 0.037	10.72 ± 0.016	6.45 ± 0.018	8.32 ± 0.012	2.20 ± 0.011	10.52 ± 0.027	6.30 ± 0.052	8.13 ± 0.034	2.14 ± 0.012	10.27 ± 0.025	6.35 ± 0.036
1	8.52 ± 0.026	2.39 ± 0.057	10.91 ± 0.054	6.63 ± 0.011	8.32 ± 0.032	2.20 ± 0.058	10.52 ± 0.028	6.40 ± 0.027	8.27 ± 0.037	2.05 ± 0.042	10.32 ± 0.058	6.18 ± 0.012	7.92 ± 0.011	2.02 ± 0.028	9.94 ± 0.018	6.02 ± 0.028
1.5	8.40 ± 0.052	2.38 ± 0.028	10.78 ± 0.067	6.60 ± 0.023	8.22 ± 0.038	2.18 ± 0.042	10.40 ± 0.052	6.27 ± 0.032	8.10 ± 0.022	1.87 ± 0.058	9.97 ± 0.017	6.02 ± 0.015	7.67 ± 0.018	1.87 ± 0.016	9.54 ± 0.038	5.78 ± 0.014
2.0	8.36 ± 0.045	2.30 ± 0.034	10.66 ± 0.028	6.45 ± 0.054	8.10 ± 0.017	2.03 ± 0.048	10.13 ± 0.058	6.10 ± 0.052	8.03 ± 0.058	1.82 ± 0.037	9.85 ± 0.027	5.83 ± 0.032	7.60 ± 0.065	1.65 ± 0.038	9.25 ± 0.045	5.67 ± 0.018

Values are Mean ± SE (n=3)

Table 3 Effect of different concentration of Lead (Pb) on Chlorophyll and Carotenoid content (mg/kg FW) in *Eichhornia crassipes* (2016)

Days►	7days				14 days				21 days				28 days			
Dose Concentration (ppm)▼	Chl a	Chl b	Total Chl	Carotenoids	Chl a	Chl b	Total Chl	Carotenoids	Chl a	Chl b	Total Chl	Carotenoids	Chl a	Chl b	Total Chl	Carotenoids
Control	6.34 ± 0.026	2.45 ± 0.026	8.79 ± 0.013	6.76 ± 0.022	6.32 ± 0.036	2.42 ± 0.042	8.74 ± 0.027	6.70 ± 0.034	6.26 ± 0.011	2.34 ± 0.037	8.60 ± 0.018	6.62 ± 0.054	6.20 ± 0.011	2.28 ± 0.045	8.48 ± 0.031	6.42 ± 0.024
0.5	6.28 ± 0.011	2.40 ± 0.037	8.68 ± 0.018	6.62 ± 0.034	6.30 ± 0.053	2.30 ± 0.053	8.60 ± 0.045	6.62 ± 0.052	6.10 ± 0.026	2.20 ± 0.016	8.30 ± 0.054	6.50 ± 0.016	6.12 ± 0.023	2.15 ± 0.037	8.27 ± 0.042	6.30 ± 0.042
1	6.24 ± 0.023	2.36 ± 0.052	8.60 ± 0.026	6.48 ± 0.043	6.10 ± 0.052	2.15 ± 0.032	8.25 ± 0.038	6.37 ± 0.027	6.00 ± 0.054	2.05 ± 0.018	8.05 ± 0.059	6.34 ± 0.032	5.90 ± 0.052	2.00 ± 0.025	7.90 ± 0.018	6.15 ± 0.062
1.5	6.17 ± 0.054	2.23 ± 0.048	8.40 ± 0.042	6.43 ± 0.027	6.00 ± 0.036	2.00 ± 0.028	8.00 ± 0.042	6.25 ± 0.051	5.92 ± 0.027	1.90 ± 0.032	7.82 ± 0.056	6.05 ± 0.047	5.70 ± 0.034	1.82 ± 0.016	7.52 ± 0.025	5.76 ± 0.057
2.0	6.10 ± 0.045	2.12 ± 0.031	8.22 ± 0.054	6.36 ± 0.045	5.90 ± 0.053	1.90 ± 0.011	7.80 ± 0.016	6.10 ± 0.026	5.68 ± 0.031	1.67 ± 0.045	7.35 ± 0.042	5.90 ± 0.052	5.49 ± 0.028	1.56 ± 0.027	7.05 ± 0.058	5.52 ± 0.018

Table 4 Effect of different concentration of Iron (Fe) on Chlorophyll and Carotenoid content (mg/kg FW) in *Eichhornia crassipes* (2016)

Days►	7days				14 days				21 days				28 days			
Dose Concentration (ppm)▼	Chl a	Chl b	Total Chl	Carotenoids	Chl a	Chl b	Total Chl	Carotenoids	Chl a	Chl b	Total Chl	Carotenoids	Chl a	Chl b	Total Chl	Carotenoids
Control	6.34 ± 0.012	2.45 ± 0.058	8.79 ± 0.014	6.76 ± 0.012	6.32 ± 0.012	2.42 ± 0.036	8.74 ± 0.025	6.70± 0.023	6.26 ± 0.052	2.34 ± 0.025	8.60 ± 0.011	6.62 ± 0.028	6.20 ± 0.012	2.28 ± 0.011	8.48 ± 0.052	6.42 ± 0.018
0.5	6.34 ± 0.034	2.42 ± 0.042	8.76 ± 0.028	6.58 ± 0.048	6.28 ± 0.036	2.38 ± 0.048	8.66 ± 0.041	6.42 ± 0.011	6.20 ± 0.038	2.18 ± 0.056	8.38 ± 0.018	6.38 ± 0.017	6.05 ± 0.024	2.05 ± 0.018	8.10 ± 0.048	6.16 ± 0.025
1	6.27 ± 0.058	2.38 ± 0.012	8.65 ± 0.032	6.50 ± 0.022	6.16 ± 0.048	2.24 ± 0.026	8.40 ± 0.068	6.28 ± 0.052	6.05 ± 0.027	2.00 ± 0.012	8.05 ± 0.027	6.20 ± 0.024	5.90 ± 0.018	1.93 ± 0.036	7.83 ± 0.012	6.02 ± 0.042
1.5	6.20 ± 0.011	2.12 ± 0.037	8.32 ± 0.022	6.47 ± 0.031	6.07 ± 0.052	2.08 ± 0.017	8.15 ± 0.053	6.10 ± 0.048	5.87 ± 0.052	1.82 ± 0.018	7.69 ± 0.031	5.92 ± 0.058	5.78 ± 0.052	1.75 ± 0.013	7.53 ± 0.027	5.86 ± 0.058
2.0	6.18 ± 0.063	2.08 ± 0.058	8.26 ± 0.012	6.40 ± 0.054	6.03 ± 0.018	2.05 ± 0.056	8.08 ± 0.058	6.04 ± 0.032	5.80 ± 0.016	1.80 ± 0.024	7.60 ± 0.027	5.67 ± 0.036	5.63 ± 0.063	1.62 ± 0.034	7.25 ± 0.032	5.34 ± 0.027

Values are Mean ± SE (n=3)

Table 5 Effect of different concentration of Lead (Pb) on Chlorophyll and Carotenoid content (mg/kg FW) in *Eichhornia crassipes* (2017)

Days►	7days				14 days				21 days				28 days			
Dose Concentration (ppm)▼	Chl a	Chl b	Total Chl	Carotenoids	Chl a	Chl b	Total Chl	Carotenoids	Chl a	Chl b	Total Chl	Carotenoids	Chl a	Chl b	Total Chl	Carotenoids
Control	7.28 ± 0.024	2.15 ± 0.017	9.43 ± 0.042	5.38 ± 0.026	7.20 ± 0.034	2.04 ± 0.053	9.24 ± 0.034	5.25 ± 0.012	7.18 ± 0.037	1.78 ± 0.018	8.96 ± 0.032	5.13 ± 0.054	7.02 ± 0.048	1.65 ± 0.026	8.67 ± 0.036	5.04 ± 0.043
0.5	7.25 ± 0.053	2.14 ± 0.025	9.39 ± 0.037	5.25 ± 0.056	7.12 ± 0.015	2.00 ± 0.041	9.12 ± 0.037	5.14 ± 0.037	7.05 ± 0.016	1.70 ± 0.052	8.75 ± 0.017	5.00 ± 0.045	6.85 ± 0.036	1.54 ± 0.038	8.39 ± 0.025	5.00 ± 0.053
1	7.22 ± 0.074	2.03 ± 0.016	9.25 ± 0.067	5.25 ± 0.046	7.00 ± 0.027	1.90 ± 0.028	8.90 ± 0.015	5.00 ± 0.016	6.89 ± 0.038	1.65 ± 0.038	8.54 ± 0.026	4.80 ± 0.017	6.70 ± 0.051	1.49 ± 0.016	8.19 ± 0.018	4.98 ± 0.038
1.5	7.16 ± 0.052	1.80 ± 0.035	8.96 ± 0.042	5.10 ± 0.037	6.57 ± 0.052	1.87 ± 0.041	8.44 ± 0.052	4.87 ± 0.045	6.50 ± 0.045	1.52 ± 0.025	8.02 ± 0.016	4.67 ± 0.048	6.50 ± 0.038	1.36 ± 0.029	7.86 ± 0.015	4.54 ± 0.037
2.0	7.15 ± 0.026	1.78 ± 0.028	8.93 ± 0.027	5.04 ± 0.042	6.50 ± 0.027	1.72 ± 0.013	8.22 ± 0.015	4.85 ± 0.028	6.34 ± 0.016	1.50 ± 0.032	7.84 ± 0.057	4.56 ± 0.025	6.35 ± 0.062	1.34 ± 0.037	7.69 ± 0.042	4.32 ± 0.015

Table 6 Effect of different concentration of Iron (Fe) on Chlorophyll and Carotenoid content (mg/kg FW) in *Eichhornia crassipes* (2017)

Days►	7days				14 days				21 days				28 days			
Dose Concentration (ppm)▼	Chl a	Chl b	Total Chl	Carotenoids	Chl a	Chl b	Total Chl	Carotenoids	Chl a	Chl b	Total Chl	Carotenoids	Chl a	Chl b	Total Chl	Carotenoids
Control	7.28 ± 0.016	2.15 ± 0.026	9.43 ± 0.042	5.38 ± 0.048	7.20 ± 0.012	2.04 ± 0.015	9.24 ± 0.023	5.25 ± 0.012	7.18 ± 0.016	1.78 ± 0.015	8.96 ± 0.011	5.13 ± 0.011	7.02 ± 0.018	1.65 ± 0.015	8.67 ± 0.027	5.04 ± 0.025
0.5	7.24 ± 0.012	2.14 ± 0.048	9.38 ± 0.037	5.35 ± 0.011	7.15 ± 0.026	2.00 ± 0.017	9.15 ± 0.048	5.19 ± 0.018	7.05 ± 0.028	1.67 ± 0.017	8.72 ± 0.026	5.05 ± 0.027	6.82 ± 0.027	1.50 ± 0.024	8.32 ± 0.016	4.80 ± 0.018
1	7.20 ± 0.018	2.05 ± 0.024	9.27 ± 0.022	5.27 ± 0.025	7.09 ± 0.015	1.92 ± 0.028	9.01 ± 0.016	5.07 ± 0.026	6.89 ± 0.017	1.60 ± 0.032	8.49 ± 0.012	5.03 ± 0.038	6.67 ± 0.058	1.43 ± 0.018	8.10 ± 0.029	4.67 ± 0.022
1.5	7.18 ± 0.052	2.00 ± 0.018	9.18 ± 0.015	5.26 ± 0.017	7.00 ± 0.028	1.87 ± 0.043	8.87 ± 0.027	5.06 ± 0.053	6.70 ± 0.048	1.50 ± 0.018	8.20 ± 0.028	4.76 ± 0.025	6.59 ± 0.017	1.29 ± 0.027	7.88 ± 0.014	4.50 ± 0.018
2.0	7.10 ± 0.047	1.98 ± 0.014	9.08 ± 0.018	5.08 ± 0.048	6.90 ± 0.052	1.78 ± 0.011	8.68 ± 0.015	5.00 ± 0.043	6.56 ± 0.038	1.48 ± 0.015	8.04 ± 0.037	4.68 ± 0.017	6.43 ± 0.042	1.19 ± 0.038	7.62 ± 0.011	4.18 ± 0.031

Values are Mean ± SE (n=3)

Table 1 (a) Comparison between Different dose concentrations of Lead (Pb) and Observation Days in *Eichhornia crassipes* in 2015

Comparison	Different dose concentration of Lead (Pb)		Observation Days	
	SE (d)	CD (P=0.05)	SE (d)	CD (P=0.05)
Chl a	0.019	0.038	0.017	0.034
Chl b	0.012	0.025	0.011	0.022
Total Chl.	0.028	0.057	0.025	0.051
Carotenoids	0.017	0.034	0.015	0.031

Table 2 (a) Comparison between Different dose concentration of Iron (Fe) and Observation Days in *Eichhornia crassipes* in 2015

Comparison	Different dose concentration of Iron (Fe)		Observation Days	
	SE (d)	CD (P=0.05)	SE (d)	CD (P=0.05)
Chl a	0.074	0.150	0.066	0.134
Chl b	0.054	0.109	0.048	0.097
Total Chl.	0.086	0.174	0.077	0.156
Carotenoids	0.042	0.086	0.038	0.077

Table 3 a Comparison between Different dose concentration of Lead (Pb) and Observation Days in *Eichhornia crassipes* in 2016

Comparison	Different dose concentration of Lead (Pb)		Observation Days	
	SE (d)	CD (P=0.05)	SE (d)	CD (P=0.05)
Chl a	0.023	0.047	0.020	0.042
Chl b	0.018	0.037	0.016	0.033
Total Chl.	0.041	0.084	0.037	0.075
Carotenoids	0.029	0.058	0.026	0.052

Table 4 a Comparison between Different dose concentration of Iron (Fe) and Observation Days in *Eichhornia crassipes* in 2016

Comparison	Different dose concentration of Iron (Fe)		Observation Days	
	SE (d)	CD (P=0.05)	SE (d)	CD (P=0.05)
Chl a	0.036	0.072	0.032	0.065
Chl b	0.033	0.067	0.029	0.060
Total Chl.	0.080	0.161	0.071	0.144
Carotenoids	0.068	0.138	0.061	0.123

Table 5 a Comparison between Different dose concentration of Lead (Pb) and Observation Days in *Eichhornia crassipes* in 2017

Comparison	Different dose concentration of Lead (Pb)		Observation Days	
	SE (d)	CD (P=0.05)	SE (d)	CD (P=0.05)
Chl a	0.048	0.087	0.043	0.087
Chl b	0.023	0.047	0.020	0.042
Total Chl.	0.056	0.114	0.050	0.102
Carotenoids	0.044	0.090	0.039	0.080

Table 6 a Comparison between Different dose concentration of Iron (Fe) and Observation Days of *Eichhornia crassipes* in 2017

Comparison	Different dose concentration of Iron (Fe)		Observation Days	
	SE (d)	CD (P=0.05)	SE (d)	CD (P=0.05)
Chl a	0.082	0.166	0.073	0.148
Chl b	0.043	0.087	0.038	0.078
Total Chl.	0.062	0.125	0.055	0.112
Carotenoids	0.073	0.150	0.066	0.133

In the different days observation maximum Carotenoid was observed in 7days followed by 14days, 21days and 28days (Table-1). Different treatments of Iron (Fe) also affect the carotenoid content. It was maximum in 0.5ppm dose (6.72mg/kg FW) and in the observation day's carotenoid was also higher in 7days in comparison to 14days, 21days and 28days respectively.

It was observed that when the dose concentration of Lead or Iron and observation days were increases, the Chl 'a' , Chl 'b' and carotenoid contents in *Eichhornia crassipes* were decreases with comparison to control. High concentration of Pb inhibits chlorophyll synthesis by impaired uptake of other essential ions by plants like Mg and Fe or due to increased chlorophyllase activity. It has been shown that plants exposed to Pb ions showed a decline in the photosynthetic rate as a result of distorted carotenoid, restrained synthesis of chlorophyll, as well as deficiency of CO_2 as a result of stomatal closing (Goswami *et al.,* 2010). Similar pattern of results were observed in 2014 (Table- 3 and 4) and 2015 (Table- 5 and 6) also.

CONCLUSION

Aquatic macrophytes play an important role in structural and functional aspects of aquatic ecosystems by numerous ways. The ability of aquatic macrophytes to take up heavy metals make them acceptable research applicants especially for the treatment of effluents having medium concentration level pollutants and city sewage waters. In present investigation, the dose concentration of Lead or Iron and observation days were increases, the Chl 'a' , Chl 'b' and carotenoid contents in *Eichhornia crassipes* were decreases with comparison to control and observation day's was also higher in 7days in comparison to 14days, 21days and 28days respectively.

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