



Comparative Analysis of Effects of Heavy Metal(Cd) on Chlorophyll Content of Different Rice (*Oryza Sativa.L*) Varieties (IR.36 & Laghu) from Lower Gangetic Basin of West Bengal, India

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Abstract:

Rice is the principal cereal as well as cash crop of India, and India is also the land of rice variety. Thousands of indigenous or traditional & high yielding varieties are remain in agricultural practice. These are diverse to their yields, phsio-morphological characters as well as stress tolerance property. Now a day's heavy metal (Cd, Pb etc.) stress is a burning problem to both agricultural & non-agricultural plants. Out of different morpho metric & physiological effects, Chlorosis (i.e. lack of synthesis or accumulation of adequate amount of chlorophyll) is one of the visible symptoms of heavy metal stress. IR-36 a very popular and high yielding rice variety developed by IRRI & 'Laghu' a traditional but low yielding & low nutritional requirement rice variety (most appropriately land race) of West Bengal are artificially treated with heavy metal cadmium (Cd). Then chlorophyll was extracted from this salt treated as well as controlled rice plant and analysed chlorophyll content by using Arnon (1949) method. Result Indicate Laghu is more heavy metal stress tolerant than highly yealding variety IR 36 in this regard (i.e. Chlorophyll Content).

Keywords: Rice variety, IR 36, Laghu, Heavy metal (Cd), Heavy metal stress chlorosis, chlorophyll

1. INTRODUCTION:

'Heavy metals' is a general collective term, applies to the group of metals and metalloids with atomic density greater than 4gm/cm³ or 5 times than water (Hawkes'1997). Among a variety of heavy metals Cadmium (Cd) is most common in environment due to several natural as well as anthropogenic factors & focussed in our study. Usually the levels of heavy metals in agricultural soil are very low. But continuous applying of different kinds of chemical fertilizers (mainly Nitrogen & Phosphate containing fertilizers) increase its amount, as different heavy metals -Cd, Pb, Hg remains as impurity of it (Raymond wuana & Felix okieinson). According to Yanqun et al (2005) Cd enrichment Occurs due to the application of sewage sludge (RP singh, M. Agarwal). Apart from all of this rapidly increasing energy supplying power stations such as coal burning power Plants became a major threat by emitting a great amount of Cd in atmosphere (Verkleji,1993) in our Study area (i.e. Katwa sub-division of West Bengal) NTPC is establishing a mega thermal Power Plant. Laghu is a traditional indigenous rice variety (or land race) of West Bengal Though it is low yielding but nutritional requirement i.e. fertilizers requirement also low and tolerant to any kind of abiotic & biotic stress (i.e. flood, storm, drought etc) (V.Singh & Satyaprakash). Though IR-36 is high yielding but sensitive (IR-36-The world's most popular rice-IRRI) to different types of stress. For this contrasting features this two rice varieties are focused in our study. Chlorophyll is one the Principal Photosynthetic Pigment consists of 4 tetrapyrrole ring with a central magnesium (Mg⁺⁺) and long hydrophobic phytol tail (Aminot,2000) it play key role in photosynthesis and lack of it known as chlorosis. It is reported that Plants grown in soil containing high levels of Cd show visible symptoms of chlorosis. Heavy metals Particularly Cd has been

shown to interfere with uptake, transport & use of several elements such as N, Mg etc. which are essential for chlorophyll biosynthesis (Das et al-1997).

2. MATERIAL & METHODS:

(A) **Study area:** West Bengal is one of the highest rice yielding (No-1) state in India and Dist. Burdwan is known as 'paddy farm' of West Bengal. Mouza Rasui under ketugram II block of the Burdwan District (Latitude - 23.71⁰N, Longitude 88.04⁰E and Altitude 21m) is considered as experimental site. This area is virgin in respect heavy metal pollution and confirmed by soil test.

(B) **Treatment Protocol & duration :** CdSO₄.xH₂O (Cadmium sulfate) artificially supplied in a regular interval at four concentration gradient of 50, 100, 150, & 200 ppm throughout the Boro season of paddy (from 45 days booting stage to onset flowering(February'17 -April'17) in field plot.

(C) **Collection of Materials:** The fresh leaves are plucked randomly from different plot of variable concentration of both Pb & Cd separately. Besides this sample was also collected from untreated plant. Then they packed in separate marked pouch and brought to the laboratory within cryo flask.

(D) **Extraction of chlorophyll (Arnon 1949):** One gram of finely cut fresh leaves was taken from each sample and ground with 20-40ml of 80% acetone. It was then centrifuged at 5000 rpm for 5 minutes at 25°C. The supernatant was transferred and the procedure was repeated till the residues become colourless. Then the Absorbance frequency was measured with the help of UV-Spectro Photometer at 645nm 663nm against the solvent (acetone) blank.

(E) **Estimation of Chlorophyll content:** The concentrations of chlorophyll a, Chlorophyll -b and total chlorophyll were calculated using the following equation.

Total Chlorophyll: - 20.2(A645) + 8.02 (A663)
 Chlorophyll a : - 12.7 (A663) – 2.69 (A645)
 Chlorophyll b : - 22.9 (A649) – 4.68 (A663)

equation. It remains clear that chlorophyll concentration is inversely proportionate with the concentration of heavy metals. Amount of Chlorophyll become lesser with the greater amount of heavy metals (Ferhad Muradoglu, 2015& K.padmaj, 1990). Heavy metals caused chlorosis by displacing Mg⁺⁺ (Key component of chlorophyll). It is also found that effect of Cd is more on IR-36 than Laghu at the same concentration of salt.

3. RESULTS & DISCUSSION:

Throughout examination and analysis of data received after computation of absorbancy readings using Arnon's (1949)

Table.1. chlorophyll content at various concentration of Cd in compare to control (Rice variety- IR.36).

Sl No.	Conc./grade	O.D (645nm)	O.D (663nm)	Chl a (µg/ml)	Chl b (µg/ml)	Total Chl (µg/ml)
1	Control	1.062	2.297	26.31	13.56	39.87
2	50ppm	0.836	1.952	22.54	9.98	32.53
3	100ppm	0.561	1.400	16.27	6.28	22.55
4	150ppm	0.321	1.032	12.23	2.52	14.75
5	20ppm	0.251	0.777	9.190	2.11	11.30

Table. 2. Chlorophyll content at various concentration of Cd in compare to control (Rice variety-Laghu).

Sl No.	Conc./grade	O.D (645nm)	O.D (663nm)	Chl a (µg/ml)	Chl b (µg/ml)	Total Chl (µg/ml)
1	Control	1.622	2.660	28.88	25.21	54.09
2	50ppm	1.454	2.476	24.77	24.44	49.22
3	100ppm	1.236	2.395	27.08	17.08	44.16
4	150ppm	1.190	2.359	26.76	16.18	42.94
5	20ppm	1.163	2.218	25.09	16.18	41.27

Table.3. Ratio of chl-a/chl-b at different concentration of Cd in Rice variety IR – 36 & Laghu.

Sl No.	Concentration of Cd	IR-36	Laghu
1	50ppm	2.3	1.01
2	100ppm	2.6	1.6
3	150ppm	4.9	1.7
4	200ppm	4.4	1.6

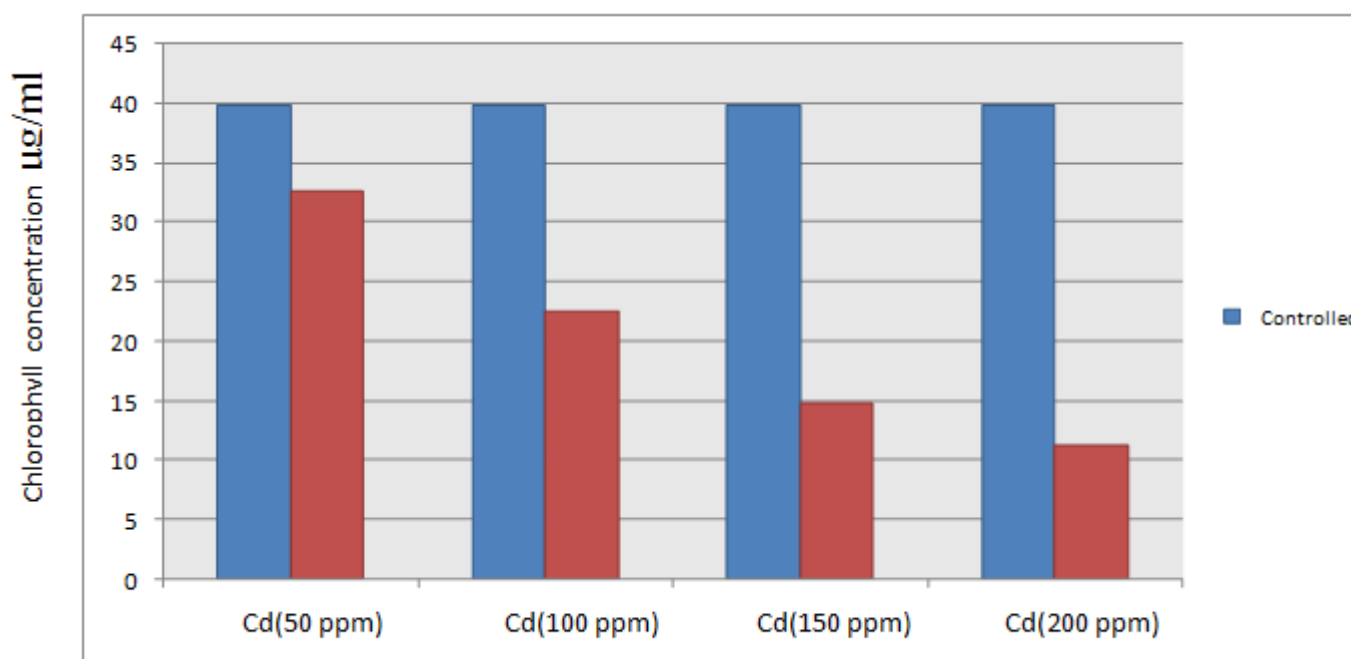


Figure.1. Comparison of Chlorophyll content of IR-36 at different concentration of Cd with controlled specimen

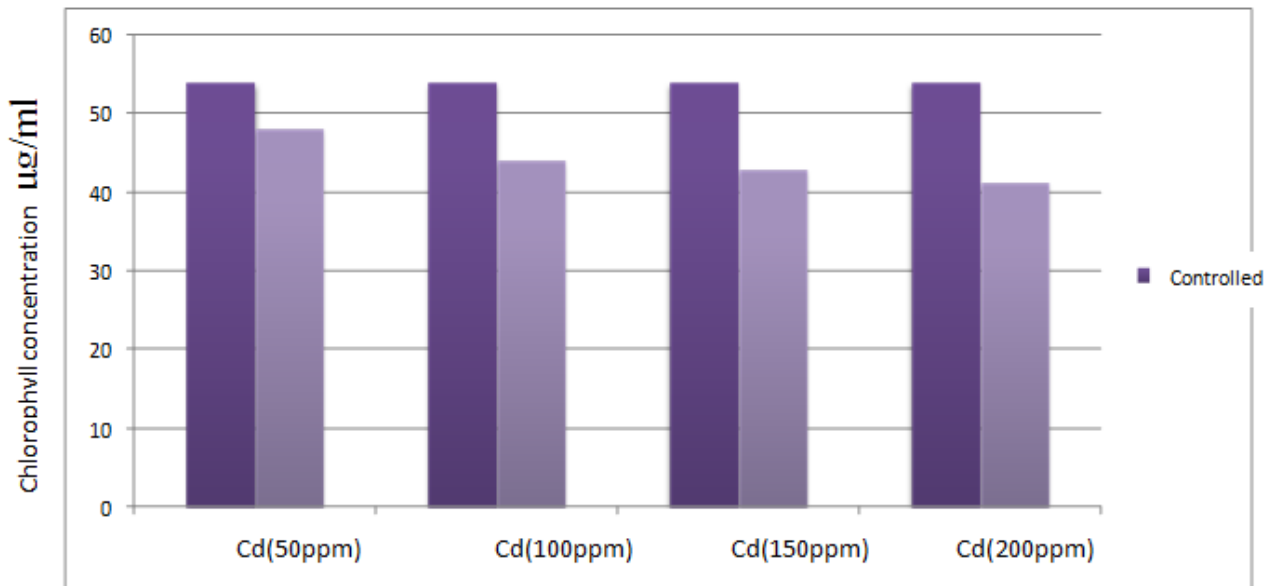


Figure.2. Comparison of Chlorophyll content of Laghu at different concentration of Cd with controlled specimen

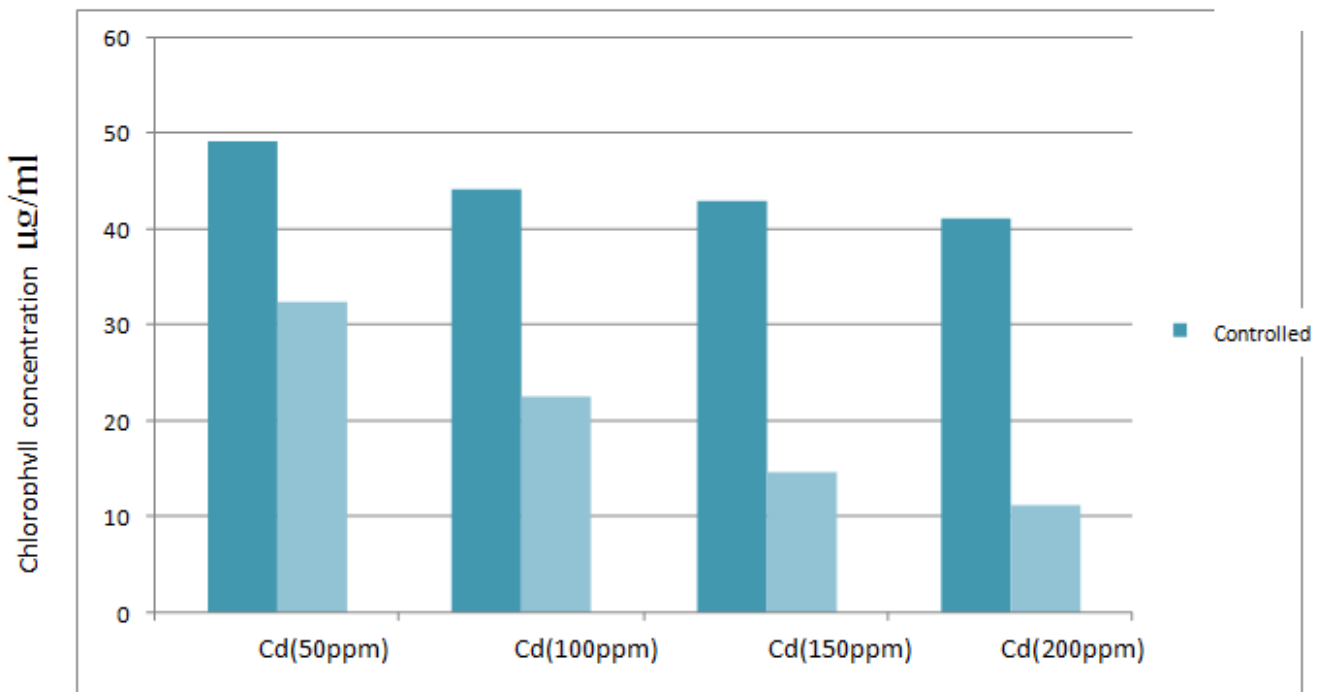


Figure.3. Comparison of Chlorophyll content in between Rice variety IR-36 & Laghu at different Cd Concentration.

Even the magnitude of change in chlorophyll Concentration at any particular concentration of Cd is more in IR-36 than Laghu (Fig-3). In compare to controlled or normal Plants and salt(Cd) treated Plants of any concentration, Chlorophyll concentration falls more in case of IR-36 than-Laghu (Fig-1 & 2). Chl a/Chl b ratio is a indication of such kind of stress condition. Usually the amount of Chl-a is great than Chl-b in any Plant at any condition(ChangF.H,1972) but amount of chl-b decreases in stress condition (R.K.Sarkar, Central Rice Research Institute .2015) Chl-a/Chl-b ratio is high in IR-36 than Laghu (Table-3).It indicate lower amount of chlorophyll-b in compare to chlorophyll-a.

4. CONCLUSION:

On the basis of the above results & discussion it can be concluded that like different kind of abiotic stress Laghu is also enable to withstand heavy metal stress well in compare to

IR-36. Though IR-36 is a high yielding variety yet in case of heavy metal stress its yielding will be less than Laghu as at the same concentration of Cd (i.e.200ppm) it losses is 72% of chlorophyll than normal condition whereas it is 24% in case of Laghu.

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