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Effects of Cadmium Chloride on Nitrate Reductse Activity and Yield Attributing Characters of *solanum melongena* L

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ABSTRACT

In the present study surface sterilized seeds of Solanum melongena L. cv. Pusa uttam were exposed to different molar conc. of cadmium viz. 10^{-2} M, 10^{-4} M, 10^{-5} M and 10^{-8} M and control for 24 hours and transferred into petriplate and polythene bags. Cadmium application inhibited various growth and biochemical parameters of Solanum melongena L. with different magnitude at higher CdCl2 level however, at lower application revealed the promotory effects. 10^{-2} M conc of cadmium chloride reduced germination (-12.06%) seedling growth (radicle & plumule length and dry weight -12.062%, -14.937% ,-43.875%, -46.112%) plant height, (-30.934%) phytomass (-32.089%), numbers of leaves and branches (-87.218% & -34.78%), leaf area (-45.37%), chlorophyll contents (Proto.chl.-34.88%, Chl.a -44.54%, Chl.b -51.48% and total clhlorophyll -46.24%) days to first flower bud initiation (-6.05%) , days to 50 % flowering (4.30%), total no. of flower (-43.40%), no. of berry(-48.56%) , 1000 seeds weight (-54.02%) , net primary productivity (-64.38%), seed yield and biological yield (-86.70% & -64.20%) and Harvest index plant^{-1} (-62.79%) of egg plant over control. Moreover, lower conc. 10^{-8} M showed promotory effects. Phytotoxicity percentage (-1.56%) and chlorophyll stability index (Chla -0.296% & Chlb 0.355%) were maximum in 10^{-2} M conc. while minimum in 10^{-8} M conc. Nitrate reductase activity and nitrite reeducates activity were reduced (-76.94% and -19.58%) respectively at higher conc

Key words : Cadmium Chloride, Solanum melongena, Chlorophyll stability index. Nitrate reductase activity and Harvest Index.

INTRODUCTION

Phytotoxic effects of cadmium chloride on germination and seedling growth have been expedited by several workers on on Urd bean (Ali Khan and Siddhu, 2006), On Solanum melongena L.(Siddhu et al., 2008), on Leucaena leucocephala (Muhammad et al., 2008) on Sorghum bicol (kuriakosa and Prasad 2008) on Vigna mungo L (Solanki et al., 2011) . Inhibiting effect of cadmium on plant growth were observed (Sandalio et al., 2001) on biomass yield (Masih et al., 2003) and on chlorophyll content (Budha and Singh 2011). Mati et al., (2002) studied the effect of Cd on germination, seedling growth and chlorophyll content of beet green Parsly, Papalo and String beans. Siddhu et al., (2008) studied the toxicity of Cd on growth and yield of Solanum melongena L. and John et al., (2009) observed the effects of heavy metal toxicity on plant growth, biochemical parameters and metal accumulation by Brassica juncea L.

Sewage irrigation and municipal based composts as fertilizer inadvertently lead to the addition of high quantity of heavy metals Heavy metals to the agro-ecosystem, which results into the deterioration of soil quality, diminution of crop yield, concomitant with deteriorated seed quality (Kumar and Dhingra 2005). Among different heavy metals, Cd is of major concern. Presence of heavy metals Heavy metals in soil is known to have potential toxic impact on environmental quality and human health via ground and surface water (Mishra and Pandey, 2005; Akinola and Ekiyoyo 2006). Moreover concentration of Heavy metals in soil may render soils non-productive because of phytotoxicity and may cause bioaccumulation of Heavy metals in human beings

(Memon et al., 2001 and Singh et al., 2006) . Application of phosphate fertilizers and agrochemicals worsens the situation further (Kumar and Dhingra 2005). Cadmium affects the plant growth, photosynthesis and metabolic process adversely which lead to diminish economic yield (Kumar and Dhingra 2005).

Cadmium induced biological effects emanate from altered translocation of ions such as Fe^{2+}, Zn^{2+}, Cu^{2+} and Mn^{2+} leading to ionic imbalance and deficiency of essential minerals due to metal ion substitution and interaction with SH- or N group of the functional enzymes. Cadmium induced deficiency of Fe^{2+} which seriously affected the photosynthesis (Alcantara et al., 1994). Cadmium also acts as an inhibitor of N.R. enzyme (Keshan and Mukherjee, 1994 and Mishra et al., 1994). The photosynthetic process is very sensitive to cadmium; it reduces growth , metabolism and low biomass accumulation (Payne and Price, 1999; Sanita and Gabbrielli, 1999). Toxicity of metal seems to be pH regulated (Pawlik et al., 1993).
Toxic effects of Cd on nitrate and nitrite reductase activity and yield attributes of Solanum melongena L. were designed in present investigation.

MATERIALS AND METHODS

Uniform healthy seeds of Solanum melongena L. cv. Pusa uttam were procured from IARI, New Delhi. These were made surface sterilized with 0.1 % $HgCl_2$ solution. In the present investigation , There were two methods of $CdCl_2$ treatment employed ie-presoaking and irrigation. For presoaking treatment sterilized seeds of egg plant were imbibed upto 24 hours in different conc. Of $CdCl_2$ viz. (10^{-2} M, 10^{-4} M, 10^{-5} M, 10^{-8} M and control) and for irrigation process $CdCl_2$ was given to soil in the form of molar concentration before sowing. Seeds were sown in polythene bags in triplicate containing 10 kgs. of sandy loam soil (pH 7.45). The experiment was conducted at Environmental Science Laboratory during the year 2005, 2006 and 2007. Observations on seedling growth, morphological and biochemical attributes were analysed. However, edaphic factors were also recorded. Data were statistically analysed by analysis of variance (ANOVA) following the method of Panse and Sukhatme (1961). The MSTATC Software & Microsoft Excel sheet were used to assess the critical difference and ± SD. Chlorophyll content was estimated by following the method of Smith and Benetiez (1955). As under-

Proto. Chlorophyll (g/l)=0.025 D_{625} -0.003 D_{662} -0.004 D_{644}

Chlorophyll stability index (C.S.I.) was calculated according to Meena et al. (2004).

Nitrate reductase activity and nitrite reductase activity (NRA) were estimated by following the method given by Sadasivum and Manickam (1992). The morphophysiological attributes such as plant height, phytomass, number of leaves, branches, leaf area, days to first flower bud initiation, days to 50 % flowering, total number of flowers, number of berry were also recorded at different DAS. Post harvest data of seed yield, biological yield, net primary productivity and harvest index/plant were recorded at harvest.

RESULTS AND DISCUSSION

Results on germination percentage , germination relative index , seedling vigour index, length and dry weight of root and shoot , number of lateral roots and shoot root ratio showed the maximum reduction at higher (10^{-2} M) conc. Moreover significant increase was observed at lower conc. (10^{-8} M) of cadmium chloride . Our observations are in agreement with that of Ali khan and Siddhu (2006), Vijayaragavan et al., (2006), Siddhu et al., (2008), Budha & Singh (2011), Solanki et al., (2011). The reduction in seedling growth could be due to the reduction in meristematic cells present in this region and some enzymes present in the cotyledons and endosperm (Kuriakosa and Prassad 2008 and Solanki et al., 2011). (Table 1).
Present investigation revealed that lower conc. showed increase in plant height and phytomass. However higher conc. 10^{-2} M hampered the plant height and phytomass significantly. Phytotoxicity percentage was observed in the following order- 10^{-2} M>10^{-4} M>10^{-5} M>10^{-8} M conc. These observations were in the agreement with those of

Mehindirata et al., (2000), Ali Khan & Siddhu (2006) and Siddhu et al., (2012). Leaves became curled and tended to abscise early in the higher conc. 10^{-2} M of $CdCl_2$. Number of leaves, branches and leaf area decreased as the conc. of metal increased. Strong decrease in leaf area was found at 10^{-2} M conc. which was correlated to accumulation of chlorophyll pigments as disturb integration of chlorophyll molecules into stable complex (Skorzynska Polit and Baszynski, 1997) (Table 2). Similar findings have been reported by Mehindirata et al., (2000) and Pandey et al., (2007).
It is obvious from the result of present investigation that reduction in the pigment contents ((Proto. Chlorophyll, Chl.a, Chl,b and total clhlorophyll) under the different treatment conditions were affected in such a way that the parameters were retarded with increasing conc. Of $CdCl_2$ by both process presoaking and irrigation (Table 3) . This decrease (at 10^{-2} M and increase at 10^{-8} M) was significant at all conc. when compared to the control condition . Mehindirata et al., (1999) , Siddhu et al., (2008) and Masih et al., (2003) have reported the same findings on Solanum melongena L. and Abelmoschus esculentus . Our observations are further conformed by Panday et al., (2007) and Budha and Singh (2011). Photosynthetic pigments were very sensitive to cadmium toxicity. Cadmium exposure have been reported to variably decreases the chlorophyll contents in Triticum aestivum. (Latif, 2008) and Brassica Juncea (Ebbs and unchil 2008). The reduction of biomass by $CdCl_2$ toxicity was considered as a direct consequenc of inhibition in chlorophyll biosynthesis (Hasan et al., 2009). In view of the data obtained in present investigation it seems reasonable to conclude that chlorophyll stability index (C.S.I.) play significant role in assessing Cd toxicity which may be a reliable index for determining the degree of Cd stress tolerance of crop plants. C.S.I. of chl. a and chl. b was reported maximum in 10^{-2} M and minimum in 10^{-8} M conc. of $CdCl_2$ (Fig. 1).

Nitrate reductase activity and nitrite reductase activity in the leaves of Solanum melongena L. cv. Pusa uttam (Table 4) have been observed inversely proportional to the conc. (10^{-2} M, 10^{-4} M, 10^{-5} M and 10^{-8} M) of $CdCl_2$. 10^{-2} M conc. significantly reduced the nitrate and nitrite reductase activity. However, 10^{-8} M conc. showed promotory effects on the activity of both the enzymes (Table 4). Our observation are agreed with those of Mishra et al. (1994), Keshan and Mukherji (1994) ,Mehindirata et al., (1999) and Solanki et al., (2011). It has been reported that NR activity depends upon active photosynthesis or production of photosynthesis as it requires photosynthetically generated reductant energy . Hence reduction in NR activity could be due to reduced photosynthesis as a result of inhibition of chlorophyll biosynthesis (Rai et al., 2004). As far the photoperiod concern flower and flower bud initiation was initiated earlier in plants exposed to lower conc. 10^{-8} M of $CdCl_2$ while higher conc. 10^{-2} M creates a disturbance in the formation of florigin harmone. Significant decline in total number of flowers plant^{-1} due to Cd^{2+} stress were observed even in the lowest dose (Table 4). Similar inhibitory effects of cadmium on flower production have been reported in mung bean (Kumar and Dhingra, 2005).
Perusal of various yield detrminants have revealed that number of seeds/berry test weight of 1000 seeds and harvest index decrease with increase in $CdCl_2$ concentration. Delterious effects of Cd on these parameters have also been reported in egg plant by Siddhu et al. (2008) and (2012). Reduction in seed yield plant^{-1} has been found to be associated with decline in number of flowers, number of seeds and seed size. Similarly reduction in accumulation in phytomass lead to decrease in net primary productivity of Solanum melongena L. at higher conc. 10^{-2} M while slight elevations have been reported in 10^{-8} M conc. Correa et al., (2006) and Budha and Singh (2011) reported the reduction in biomas accumulation in terms of (dry weight and phytomass) by contamination of cadmium chloride. Biological yield plant^{-1} was decreased in 10^{-2} M conc. of $CdCl_2$ in terms of decreased in number of berry and leaves, root and stem growth while lower conc. promotes the growth of these attributes (Table 4). Kumar and Dhingra (2005) has reported the same findings in case of mung bean. Our observations are further in conformity with that of Siddhu et al., (2008) and (2012).
Data on the edaphic factor of soil revealed that pH of soil decreased with increase in soil Cd conc. Pawlik et al., (1993), Smith (1994). reported that soil pH controlled the Cd availability in soils and decreasing soil pH value

increases the cadmium uptake by crops. A comparison of data on N.P.K. contents of soil revealed that N.P.K. contents increased with decreasing cadmium concentration in soil for phytoremediation (Table 5).

It can be concluded that toxic effects of cadmium with respect to Solanum melongena L. is maximum at higher conc. 10^{-2} M while minimum at lower conc. 10^{-8} M during early stage and the plant become more resistant to this metal as it attains maturity .

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Table-1 : Effect of cadmium chloride on seedling growth of *Solanum melongena* L.

DAS	Germination percentage	Germination relative index (G.R.I.)	Seedling vigour index (S.V.I.)	Number of lateral roots	Radicle length	Plumule length	Phytotoxicity percentage of radicle length	Phytotoxicity percentage of plumule length	Shoot root ratio (SRR)	Dry weight of radicle	Dry weight of plumule
3	23.33±02	265.62±0.30	-	-	-	-	-	-	-	-	-
5	85.00±0.82	935.00±0.82	444.805±2.45	-	5.233±0.054	-	-	-	-	0.538±0.003	-
7	96.66±0.82	1024.49±1.22	1123.189±2.06	5.482±0.12	7.676±0.092	3.945±0.035	-	-	3.378±0.01	0.740±0.009	2.500±0.053
10	96.66±0.82	966.50±0.86	1320.955±1.63	7.524±0.131	7.886±0.063	5.780±0.152	-	-	3.129±0.10	0.926±0.005	2.900±0.066
3	3.33±0.16	75.81±0.82	-	-	-	-	-	-	-	-	-
5	38.33±1.09	660.00±1.021	132.851±0.74	-	3.466±1.32	-	33.766±0.13	-	-	0.301±0.001	-
7	85.00±0.82	935.98±0.82	659.175±1.64	2.055±0.08	5.022±0.84	2.733±0.12	34.566±0.24	37.224±0.18	3.759±0.01	0.398±0.003	1.500±0.090
10	85.00±0.82	883.00±1.012	845.920±0.80	2.300±0.012	6.708±0.56	3.244±0.08	14.937±0.04	43.875±0.10	4.030±0.06	0.499±0.001	2.011±0.011
3	5.00±0.16	132.81±1.63	-	-		-	-	-	-	-	-
5	43.33±1.09	806.30±1.06	350.232±1.25	-	3.821±0.82	-	26.982±0.11	-	-	0.424±0.004	-
7	88.33±0.55	971.49±1.22	762.152±0.01	3.045±1.26	5.453±1.06	2.862±1.32	28.951±.047	27.452±0.36	3.924±0.05	0.506±0.003	1.987±0.056
10	88.33±1.09	916.50±0.86	1041.807±0.82	3.142±1.32	7.224±1.25	4.142±0.82	8.394±.020	28.339±0.26	3.356±0.22	0.656±0.002	2.202±0.157
3	6.66±0.02	151.62±0.82	-	-	-	-	-	-	-	-	-
5	63.33±0.54	916.30±0.57	435.780±0.82	-	4.842±0.08	-	7.471±0.33	-	-	0.452±0.003	-
7	90.00±0.82	988.98±1.57	898.830±1.65	3.400±1.08	6.850±1.02	3.137±1.65	10.749±0.15	20.468±0.5	3.802±0.35	0.555±0.00	2.112±0.

										5	92
10	90.00±0.82	933.00±1.26	1085.760±0.83	4.500±1.14	7.564±1.00	4.500±0.56	4.0831±0.09	22.145±0.11	2.928±0.05	0.838±0.002	2.454±0.177
3	25.00±0.82	272.16±0.82	-	-	-	-	-	-	-	-	-
5	86.66±0.87	953.15±0.48	559.360±0.81	-	5.888±1.22	-	12.516±0.08	-	-	0.545±0.002	-
7	98.00±0.82	1041.98±0.81	1186.486±1.63	6.857±0.15	7.875±1.06	4.232±0.163	-2.605±0.37	-7.25±0.19	3.542±0.06	0.751±0.008	2.662±0.163
10	98.00±0.82	983.00±0.82	1358.966±0.48	8.421±0.82	7.999±1.06	5.868±0.012	-1.432±0.0	-1.552±.02	3.210±0.16	0.945±0.014	3.200±0.063

DAS = Days after sowing
Values are mean of three replicates.
±SD

Table - 2 : Effect of cadmium chloride on number of leaves branches, leaf area cm^2, plant height (cm) phytotoxicity % and phytomass (gm)/plant of *Solanum melongena* L

Parmeters	CdCl2 treatment	Plant age days					
		30	45	60	75	90	105
Number of leaves/plant	Control	4.16±0.16	0.016±0.016	8.81±0.008	9.00±0.104	11.666±0.002	7.021±0.003
	10^{-2} M	3.00±0.125	3.12±0.021	5.875±0.002	7.40±0.125	8.200±0.163	5.110±0.036
	10^{-4} M	3.30±0.082	3.50±0.082	7.522±0.002	8.00±0.102	8.760±0.021	6.214±0.003
	10^{-5} M	3.66±0.125	4.00±0.086	7.980±0.057	8.2±0.163	10.540±0.041	6.780±0.021
	10^{-8} M	4.25±0.029	4.35±0.033	9.100±0.094	10.5±0.082	12.011±0.0003	8.224±0.003
Leaf area cm^2/plant	Control	83.200±0.12	93.297±0.0	407.022±0.001	1530.00±0.57	2070.1310.00	1283.84±0.0
	10^{-2} M	30.606±0.0	41.589±0.0	217.775±0.00	949.05±0.03	1083.302±0.01	701.245±0.0
	10^{-4} M	47.850±0.03	70.560±0.02	253.867±0.00	1152.00±0.62	1316.119±0.01	965.786±0.0
	10^{-5} M	6800±0.12	82.207±0.00	319.200±0.02	1191.05±	1598.285±0.01	1072.663±0.0
	10^{-8} M	90.202±0.00	104.400±0.00	425.420±0.00	1848.00±1.00	2200.995±0.00	1553.711±0.00
Number of branches/plant	Control	-	-	1.621±0.03	1.857±0.003	2.200±0.163	2.300±0.125
	10^{-2} M	-	-	1.221±0.02	1.400±0.087	1.457±0.003	1.500±0.125
	10^{-4} M	-	-	1.320±0.021	1.420±0.034	1.533±0.003	1.667±0.023
	10^{-5} M	-	-	1.420±0.016	1.577±0.002	1.650±0.024	1.768±0.002
	10^{-8} M	-	-	1.823±0.002	2.111±0.006	2.310±0.021	2.420±0.033

Plant height (cm)/plant	Control	5.800±0.012	7.720±0.011	11.942±0.012	15.686±0.010	16.742±0.082	17.841±0.089
	10^{-2} M	3.200±0.006	4.500±0.005	8.725±0.033	10.342±0.015	11.989±0.072	12.322±0.0165
	10^{-4} M	4.000±0.007	6.200±0.014	10.856±0.046	12.412±0.013	13.120±0.026	14.012±0.0122
	10^{-5} M	4.800±0.009	6.800±0.022	11.022±0.044	13.440±0.019	14.240±0.023	15.421±0.0125
	10^{-8} M	6.800±0.012	8.450±0.052	12.982±0.012	15.878±0.022	17.071±0.092	18.120±0.009
P.P. of stem/plant	Control	-	-	-	-	-	-
	10^{-2} M	44.827±0.003	41.709±0.008	26.938±0.001	34.068±0.009	28.389±0.125	30.934±0.125
	10^{-4} M	31.034±0.014	19.689±0.024	9.093±0.033	20.872±0.082	21.634±0.082	21.461±0.0125
	10^{-5} M	17.241±0.0122	11.917±0.022	7.703±0.038	14.318±0.09	14.944±0.065	13.564±0.021
	10^{-8} M	-22.413±0.015	-9.455±0.001	-8.708±0.006	-1.224±0.016	-1.965±0.017	1.563±0.0125
Phytomass (gm)/plant	Control	0.0980±0.00	0.1281±0.0	0.625±0.00	3.14±0.002	1.965±0.002	7.984±0.002
	10^{-2} M	0.0651±0.00	0.0760±0.0	0.4420±0.00	0.7135±0.02	3.411±0.003	5.422±0.0002
	10^{-4} M	0.0870±0.0	0.0982±0.0	0.5452±0.00	1.2225±0.0003	4.214±003	6.787±0.002
	10^{-5} M	0.0941±0.0	0.1214±0.0	0.5820±0.002	2.2270±0.002	4.334±0.002	7.654±0.002
	10^{-8} M	0.1052±0.0	0.1370±0.0	0.8750±0.003	3.4100±0.002	6.522±0.002	8.724±0.003
Values are mean of three replicates. ±SD							

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Table-3 : Effect of cadmium chloride ($CdCl_2$) on chlorophyll contents (g/g. f. wt.)of Solanum melongena L. cv. Pusa uttam.

Particulars	DAS	CdCl2 treatment	P. chl.	Chl. a	Chl. b	Total chl.
Preasoaking treatment	30th	Control	1.609±0.004	0.4143±0.00	0.1099±0.003	0.5241
		10^{-2} M	1.4330±0.003	0.2913±0.001	0.0708±0.00	0.3622±0.001
		10^{-4} M	1.4602±0.002	0.3216±0.003	0.0759±0.00	0.3975±0.001
		10^{-5} M	1.501±0.005	0.3475±0.001	0.0987±0.00	0.4463±0.001
		10^{-8} M	1.541±0.002	0.3729±0.003	0.107±0.001	0.4799±0.001
	60th	Control	0.689±0.003	0.19245±0.001	0.05083±0.00	0.2433±0.0.001
		10^{-2} M	0.4205±0.001	0.1282±0.001	0.0301±0.00	0.1374±0.001
		10^{-4} M	0.5075±0.003	0.1421±0.001	0.0395±0.00	0.1816±0.001
		10^{-5} M	0.5538±0.002	0.1564±0.001	0.04348±0.004	0.1990±.001
		10^{-8} M	0.6195±0.001	0.1785±0.001	0.0469±0.013	0.2626±0.00
	90th	Control	0.563±0.001	0.1549±0.00	0.04852±0.001	0.2035±0.00
		10^{-2} M	0.3666±0.00	0.0859±0.00	0.2353±0.003	0.1094±0.00
		10^{-4} M	0.4790±0.001	0.1207±0.001	0.0310±0.001	0.1517±0.01
		10^{-5} M	0.5220±0.00	0.1419±0.00	0.0395±0.002	0.1814±0.001
		10^{-8} M	0.5404±0.002	0.1504±0.001	0.0404±0.00	0.1970±0.001
Irrigation treatment	30th	Control	1.735±0.002	0.5788±0.001	0.168±0.003	0.7468±0.001
		10^{-2} M	1.2582±0.002	0.2424±0.003	0.1450±0.004	0.2569±0.001
		10^{-4} M	1.3805±0.002	0.3254±0.004	0.0564±0.061	0.4096±0.001
		10^{-5} M	1.627±0.003	0.3801±0.00	0.0682±0.012	0.4483±0.00
		10^{-8} M	1.702±0.006	0.4223±0.003	0.0723±0.040	0.4946±0.001
	60th	Control	1.1797±0.001	0.36038±0.002	0.0986±0.006	0.459±0.031
		10^{-2} M	0.6386±0.00	0.07018±0.011	0.0290±0.012	0.0992±0.021
		10^{-4} M	0.7335±0.003	0.2133±0.06	0.2956±0.003	0.2428±0.0011
		10^{-5} M	0.7842±0.004	0.2185±0.032	0.0364±0.003	0.2549±0.03
		10^{-8} M	0.9285±0.00	0.2265±0.006	0.0423±0.006	0.2688±0.001

P.chl=Proto chlorophyll
DAS = Days after sowing
Values are mean of three replicates. ±SD

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Table-4: Effect of cadmium chloride on flowering, post harvest characters , nitrate reductase activity (µg. NO2-- prod/min/gm.f.wt.) and
nitrite reductase activity (µg).NO2--red./min/gm.f.wt.) of *Solanum melongena* L.

CdCl2 treatment	Days to first flower bud initiation	Days to 50 % flowering	Total no. of flowers plant-1	Number of beery plant-1	1000 seeds weight (gm)	Net primary productivity	Seed yield plant^{-1} (gm)	Biological yield plant^{-1} (gm)	Harvest index plant^{-1}	Nitrate reductase activity	Nitrite reductase activity
Control	60.660±0.471	77.33±0.943	6.750±0.053	2.333±0.005	1.416±0.001	0.146±0.00	3.1731±0.02	17.576±0.083	18.0533±0.001	5.825±0.001	0.143±0.03
10^{-2} M	64.33±0.471	80.66±0.943	3.820±0.087	1.2±0.082	0.651±0.001	0.052±0.00	0.422±0.02	6.292±0.081	6.717±0.004	1.343±0.002	0.115±0.001
10^{-4} M	62.660±0.471	78.33±0.471	5.220±0.046	1.4±0.082	0.652±0.005	0.0121±0.00	0.773±0.049	10.942±0.092	7.543±0.002	2.223±0.001	0.127±0.001
10^{-5} M	61.33±0.943	77.66±0.471	5.410±0.012	1.6±0.082	0.662±0.001	0.092±0.00	0.847±0.003	11.132±0.094	7.613±0.00	2.506±0.002	0.132±0.001
10^{-8} M	60.330±0.471	76.66±0.471	6.400±0.02	1.8±0.082	0.692±0.001	0.095±0.00	1.045±0.003	11.485±0.004	9.099±0.296	4.770±0.011	0.140±0.001

Table-5 : Effect of cadmium chloride on physiochemical characteristics of soil after harvest.

Particulars	CdCl2 treatment	pH	E.C. (mho cm^{-1})	N_2 µg gm dw^{-1} of soil	P mg gm dw^{-1} of soil	K mEq gm dw^{-1} of soil
$CdCl_2$	Control	7.45±0.022	0.123±0.004	0.449±0.005	0.362±0.003	1.42±0.040
	10^{-2} M	5.82±0.077	0.418±0.003	0.232±004	0.222±0.003	1.072±0.020
	10^{-4} M	6.23±0.017	0.390±0.006	0.258±0.002	0.254±0.004	1.121±0.004
	10^{-5} M	6.46±0.079	0.284±0.003	0.317±0.006	0.278±0.002	1.286±0.002
	10^{-8} M	6.66±0.025	0.276±0.004	0.432±0.004	0.292±0.004	1.361±0.005

Values are mean of three replicates. ±SD

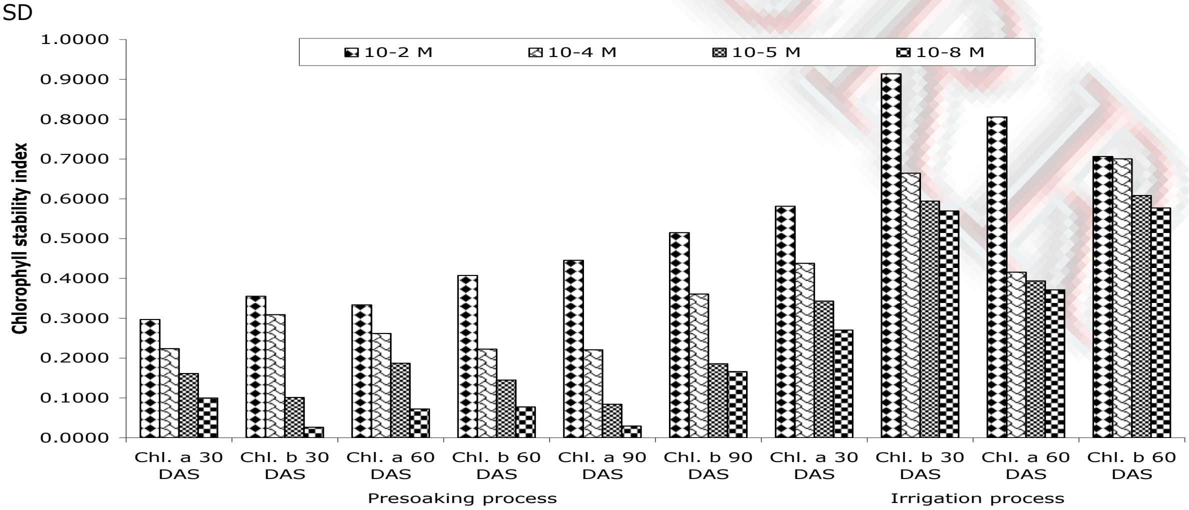

Fig.: 1 . Effect of cadmium chloride (CdCl2) on chlorophyll stability index (CSI)of Solanum melongena L. by presoaking and irrigation process.

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