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Effects of Gibberellic Acid under Cadmium Chloride Stress on Maize (*Zea mays* L.)

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ABSTRACT

Maize is very essential crop and positioned third in the globe after *Triticumastivium* and *Oryza sativa* according to the producing area. Cadmium is the metal that affects various grain crops and gibberellic acid is a useful hormone against a variety of stress. To determine the effect of GA and Cd, pot research was conducted in the OLD Botanical Garden Agriculture University Faisalabad. Two different types of corn were used (Neelam and Desimakai). The concentrations of cadmium chloride were (0 μM and 200 μM) and Gibberellic acid concentration (0mg and 0.25 mg) were applied. Stress was applied after every 10 days, and gibberellic acid was applied once in three leaves stage. After 60 days the plants were harvested. After this different growth, morphological and physiological parameters were evaluated. The investigation was carried out in a CRD with three replicates. The data will be checked statistically using computer analysis.

Keywords: Maize, Gibberellic Acid, Yield, Botanical Garden,UAF

INTRODUCTION

The primary cereal yield is maize which is the principal requirement of diet and very important oil is obtained from maize necessary for human development. Maize is consumed as feed for domesticated animals all the world [1]. Corn is consumed as a breakfast food in the circle. Maize is the vital cereal edit which is the indispensable requirement of crops. The oil obtained from

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maize is important for the nourishment of animals [2]. Maize (corn) has a position with family Poaceae. Corn is the central production between grain after Triticumastivum and Oryza sativa in view of production world. Corn seeds have starch (70%), protein (12%), oil (5.8%), fiber (4.8%), sugar (2.0%), and powder (2.7%) [3]. Environment of PAK is perfect for agriculture development. Various elements oversee the low yield of the crop. Unseemly harvest nourishment administration and poor soil ripeness are the most imperative elements in charge of low yield. Nitrogen assumes a critical part in crop development and yield [4]. In rising countries this problem has appeared from long-standing consumption of organic waste stream for water system prompting expanded concentrations organic metals in earth [5,6]. This remains flora from attained their mainly excessive traditional impending for growth, development, and replicate. Just the once accumulate on the soil flora can take up this mechanism from the ground and transport them into the ordinary way of life increasing the hazard of metal harmfulness reservations for people and creatures [7,8]. At high Concentrations every single substantial metal has solid harmful impacts and are viewed as natural poisons [9,10]. Substantial metal contamination in agricultural soils may prompt abnormalities in the shape of soil, difficulty in growth of plants moreover damage health of human during inflowing the normal chain of food. Repository residue and extracts are required to collect large metals to such an amount to these metals power set absent in mud and go into the farming soil [11]. Among substantial metals Cadmium is extremely dangerous to growth of plants and being yet at low amount due to its non-liveliness in living things. Cadmium violated cereal is the standard source of cadmium passageway to people by means of the evolved way of life [12,13]. Cadmium is oxidative metal, due to this cadmium activated all the non-redox stress in different plants at the cell stage. As well as cadmium enhanced the gathering as well as combination of all those things which are part of reactive oxygen species (here we take example radical of superoxide, H_2O_2 and hydroxyl radicals [14]. They cause termination of plant cell due to the process of lipid peroxidation, protein oxidations and destroyDeoxy-Ribo Nucleic acid Yet reactive oxygen species have equally come out to power the declaration of several trait [15].During the restoration of inhibitory contact of reactive oxygen species, plants may develop some important things in cell these are against oxidant protection mechanism which may include enzymatic actions and non-enzymatic actions and system of protection [16,17]. Cadmium is not harmful to plants at very low amount, but the higher amount of cadmium chloride may cause decreased in the root growth and all the growth processes taking place in plants [18,19]. Cadmium toxicity manifestations are like iron deficiency cause the yellowing of leaves in plants and moreover cadmium initiate complete cell death and cell shrinkage. One more famous emphasis towards the issue of cadmium pollution through the help of the development of recent industry and agriculture.Most approaches do not give accurate answer about ordinary remediation for toxicity feature caused by metal pollution. The development of plants remediation improvement for location cleanse has prompted delayed attention for the machinery by which metals are composed in flora[20]. The aim of current study to prepare the role of gibberellic acid against heavy metal stress and the response of gibberellic acid indulgence plants to non-bio accumulative heavy metal anxiety to justify the effect of the stress of cadmium chloride in corn.

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MATERIAL AND METHODS

The current study was performed in Botany department UAF Pakistan. Kernels of two maize cultivators (Neelum and DesiMakai) were taken from Sargodha city. The research was set in Old Botanic Garden (UAF). The trial was performed in complete randomized design (CRD).

Sowing and Culture medium

Kernels of corn were grown in artificial tubs containing 7 kilo gram sand in per pot. Seedlings were thinned after the germination, ten seedlings per pot of almost uniform size. There were used two levels i.e. (0µm and 200µm) $CaCl_2$ and GA i.e. (0mg and 0.25 mg) .

Morphological Parameters:

It includes shoot measurement, Rhizome measurement, fresh mass of shoot, Oven dry mass of shoot, fresh mass of Rhizome, Oven dry mass of dry rhizome, amount of vegetation for each plant, Leaf region, Tallness ofplants. there are different parameters include, Shoot length (cm):Branch length was calculated through the help of inch tape.Root length (cm):Rhizome length was calculated through the help of inch tape.Shoot fresh mass (g):Branch fresh mass was calculated using weight machine.Shoot dry mass (g):Branch was air dried for two days and then it was placed in oven at 65 degree for seven days.Shoot dry mass was calculated through the help of weight machine.Root fresh mass (g):Rhizome fresh mass was calculated through the help of weight machine.Root dry mass (g):Root was air dried for two days and then it was placed in oven at 65 degree for seven days and measured through the help of weight machine.Numbers of Leaves:Total number of leaves per plants was calculated.Plant Height:Calculated with the help of inch tape.Leaf area:For measuring leaf area maximum length and maximum size of leaf was calculated through subsequent equation leaf area was measured.Total leaf area = maximum leaf length × maximum leaf width × correction factorCorrection factor for maize leaf is 0.68.

Gas exchange attributes

Calculation of net CO_2 incorporation speed (A), water evaporation rate (E), stomatal conductance (gs) and Sub stomatal Co_2 concentration (Ci) was complete on fresh green and completely grown leaf mostly the top of the leaf were taken, of every maize plant through an structure convenient IRGA (analytical development company). These calculations were taken at the time of complete sun rise from 10 to 12pm. And using the subsequent requirement ambient CO_2 absorption (Cref) 371µmol/mol, ant temperature of leaf chamber diverse from 25 to 30 degree. Volume of leaf chamber gas (flw rate 9v) 296ml/min and molar gase flow of leaf chamber rate (U) 403µmol/s, ambient force (P) 97.95 K Pa, PAR (Qleaf) at surface of leaf highest up 770 µmol/m2/s.

Physiological parameters:

For determining Chlorophyll, *a*andChlorophyll *b*carotenoids a scientist AMON (1949) was formulated a method to calculate all of these. For the extraction of chlorophyll, the fresh green leaves were taken from the plant and took 0.1 g leaf and add 80% acetone in each plastic bottle, leave the mixture over dark means for 24 hours at specific temperature. Then after one night the mixture was ready for takin readings. Then centrifuge the mixture in spectrophotometer. After

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the centrifuging (at 10000 r.p.m ×) the plant mixture this mixture was worn to calculating the absorbance by using the instrument spectrophotometer (Hitachi-U,2001, Tokyo) at 645,663 and 480nm.

This is the formula used for calculations

Chl.a (mg/g)= V/1000 × W ×[12.7(OD663)-2.69(OD645)].

Chl.b (mg/g)= V/1000 × W ×[22.9(OD645)-4.68(OD663)].

Total chl . (mg/g)= V/ 1000 × W ×[20.2(OD625)-8.02(OD663)]

Craotinoid= V/1000 × W ×[(OD480) + 0.114(OD663)-0.638(OD645)]
Where
V = Volume of the acetone used in extract (ml)

W = Weight of fresh leaf tissue (g)

Evaluation of total soluble protein

Bradford method is use commonly to determine the total soluble proteins (Bradford, 1976).
Bradford reagent Mixed 100 mg Brilliant Blue G-250 in 50 ml 95% alcohol C_2H_5OH also mixed 100 ml 85% (w/v) phosphoric acid. Added one liter water to dilute the mixture and when color was fully mixed and filter this material using Whatman #1 one paper. the extraction of proteins we took 0.5 g fresh green leaves, and these leaves were mixed through plant grinding machine in 5 ml of 50 mM chilled buffer phosphate (pH 7.8) after this put in the cool tub. This mixture was centrifuged at 15000 rpm for 15 minutes. This mixture was used for the determination of protein. Every of the sample 100 µl, was placed in tube and mix with 1.0 ml of Bradford reagent. These plant sample martial were heated at 37^{o}C for 10-15times with the blank readings and absorbance was observed at 595 nm.

Peroxidase (POD)

Made the 3ml Peroxidase mixture (3ml) this mixture had contained 40mM hydrogen peroxide, 50mM Potassium Phosphate Buffer (PH7.8), 20mM Guaiacol and 100µl of enzymes take out. After prepared this mixture change absorbance at 470nm. And taken reading after each 20 seconds. Peroxidase activity was defined as the 0.01 absorbance unit per min mg of proteins.

STATISTICAL ANALYSIS

The facts will be investigated by means of ANOVA procedure recommended [21].

Result:

Shoot fresh weight (g):

Anova of numbers for shoot fresh weight (g) of 2 maize Cultivars (Neelam and Desimakai)

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matured in control environment and $CdCl_2$ tension. Application of Gibberellic acid cause significantly ($p \leq 0.05$) improved in the branch fresh mass of Desimakai on the other hand greatest decline in branch fresh mass was noted in Neelam at what time 200µm $CdCl_2$ was used. On the other hand, greatest raise in branch fresh mass was detected in Desimakai at 0µm $CdCl_2$ and 0.25mg GA_3 spray. Varietal significant ($p \leq 0.05$) dissimilarity was detected between mutually cultivars is given in Table.No.1.

Table.No.1: ANOVA table for Shoot fresh weight of two maize cultivars (Neelam and Desimakai) under $CdCl_2$ stress with foliar application of Gibberellic acid.

Source of variation	df	MS	F-Value	p-value
Stress	1	2962.5926	997.38839	.0000 ***
Spray	1	440.92654	148.44262	.0000 ***
Varieties	1	497.4972	167.48774	.0000 ***
Stress X Spray	1	42.055537	14.158445	.0017 **
Stress X varieties	1	563.8612	189.82989	.0000 ***
Spray X varieties	1	1377.8926	463.88224	.0000 ***
Stress x spray x varieties	1	3092.8751	1041.2494	.0000 ***
Error	16	2.97035		

Non-significant=^{ns}. ***, **, * significant at 0.001, 0.01, 0.05 separately

Shoot Dry Weight (g)

Anova numbers for branch dry mass (g) of 2 maize Cultivars (Neelam and Desimakai) matured in control environment and $CdCl_2$ tension. Application of Gibberellic acid cause significantly ($p \leq 0.05$) improvement in the branch dry mass of both Neelam and Desimakai or highest decline in branch dry mass was detected in Desimakai when 200µm $CdCl_2$ was used. Moreover, highest enlargement in branch dry mass was detected in Desimakai at 200µm $CdCl_2$ and 0.25mg GAspray and 200µM $CdCl_2$. Varietal significant ($p \leq 0.05$) dissimilarity was detected between both cultivars is give in in Table.No.2.

Table.No.2: ANOVA table for Shoot Dry weight of two maize cultivars (Neelam and Desimakai) under $CdCl_2$ stress with foliar application of Gibberellic acid.

Source of variation	df	MS	F-Value	p-value
Stress	1	81.401667	123.1811	.0000 ***

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Spray	1	3.5882667	5.429946	.0332 *
Varieties	1	6.1004167	9.231458	.0078 **
Stress X Spray	1	97.284267	147.21546	.0000 ***
Stress X varieties	1	43.368817	65.6188	.0000 ***
Spray X varieties	1	0.5340167	0.8081009	.3820 ns
Stress x spray x varieties	1	16.170417	24.469889	.0001 ***
Error	16	0.6608292		

Non-significant=^{ns}. ***, **, * significant at 0.001, 0.01, 0.05 separately

Plant Height (cm)

Anova number for plant height of two maize Cultivars (Neelam and Desimakai) matured in control condition and Cadmium chloride stress. Gibberellic acid treatment effects significantly ($p \leq 0.05$) enlarged in Plant height of both veritiesNeelam and Desimaki, but maximum reduction observed in Plant height of Neelam when 200µm Cadmium chloride was applied. Desimakai performed better then Neelam under 200µm $CdCl_2$ and 0.25mg GAspray. On the other hand, highest raise in plant height was detected in Desimakai at 0.25mg GAspray as given in Fig.1. Overall, both verities showed excellent performance but Desimakai performed good as compared to Neelam. Varietal significant ($p \leq 0.05$) difference was detected between both cultivars.

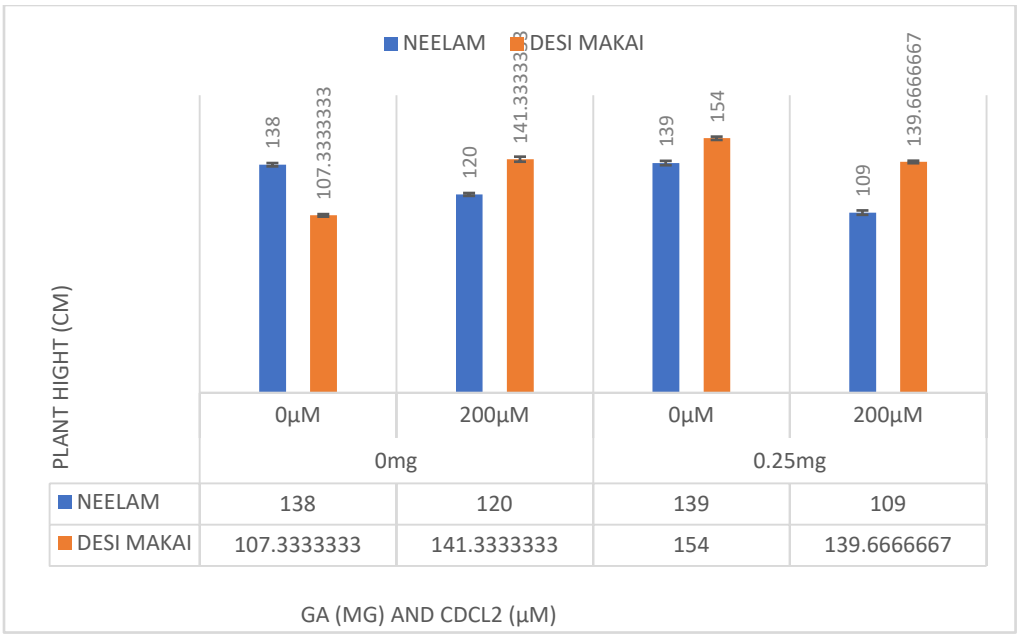

Figure.No.1: Plant height (cm) of two maize cultivars (Neelam and Desimakai) under $CdCl_2$ stress with foliar application of GA.

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Shoot length (cm):

Anova numbers for shoot length (cm) of 2 maize Cultivars (Neelam and Desimakai) grown in control condition and Cadmium chloride tension. Treatment of Gibberellic acid cause significantly ($p \leq 0.05$) enlarged in branch length of mutually Neelam and Desimakai but Desimakai performed better then Neelam in all conditions. Moreover, greatest decrease in branch length was detected in Desimakai at 200µm $CdCl_2$ and 0.25mg GAspray and 200µM $CdCl_2$. Varietal significant ($p \leq 0.05$) difference was detected between both cultivars as given in Table.No.3.

Table.No.3: ANOVA table for Shoot Dry weight of two maize cultivars (Neelam and Desimakai) under $CdCl_2$ stress with foliar application of Gibberellic acid.

Source of variation	df	MS	F-Value	p-value
Stress	1	376.04167	87.621359	.0000 ***
Spray	1	287.04167	66.883495	.0000 ***
Varieties	1	315.375	73.485437	.0000 ***
Stress X Spray	1	1305.375	304.16505	.0000 ***
Stress X varieties	1	782.04167	182.2233	.0000 ***
Spray X varieties	1	1457.0417	339.50485	.0000 ***
Stress x spray x varieties	1	165.375	38.533981	.0000 ***
Error	16	4.2916667		

Non-significant=^{ns}. ***, **, * significant at 0.001, 0.01, 0.05 separately

Root Length (cm)

Anova numbers of data for rhizome length (cm) of 2 maize Cultivars (Neelam or Desimakai) grown in control condition and Cadmium chloride tension. Treatment of Gibberellic acid cause significantly ($p \leq 0.05$) enhanced in rhizome length of Desimakai, and highest decline was detected in root length of Neelam when 200µm cadmium chloride was applied was given in (Fig. 4.7). Both Neelam and Desimakai performed better under 200µm $CdCl_2$ and 0.25mg GAspray. On the other hand, greatest enlargement in rhizome length was detected in Desimakai at 0.25mg GAspray. Overall, both verities showed excellent performance, but Neelam performed good in control condition as compared to Desimaki. Varietal significant ($p \leq 0.05$) difference was detected between both cultivars is shown in Table.4.

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Table.No.4: ANOVA table for root length (cm) of two maize cultivars (Neelam and Desimakai) under $CdCl_2$ stress with foliar application of Gibberellic acid.

Source of variation	df	MS	F-Value	p-value
Stress	1	4.1666667	10	.0060 **
Spray	1	0.1666667	0.4	.5360 ns
Varieties	1	20.166667	48.4	.0000 ***
Stress X Spray	1	0.6666667	1.6	.2240 ns
Stress X varieties	1	32.666667	78.4	.0000 ***
Spray X varieties	1	10.666667	25.6	.0001 ***
Stress x spray x varieties	1	88.166667	211.6	0000 ***
Error	16	0.4166667		

Non-significant=^{ns}. ***, **, * significant at 0.001, 0.01, 0.05 separately

Number of leaf:

Anova numbers of data for number of Leaves of two maize Cultivars (Neelam or Desimakai) grown in control condition and Cadmium chloride stress.Application of Gibberellic acid cause significantly ($p \leq 0.05$) enhanced in quantity of leaves of both of the verities Neelam and Desimaki, but maximum reduction was observed in number of leaves of Neelam when 200µm Cadmium chloride was applied was given in (Fig. 4.8). Desimakai performed better then Neelam under 200µm $CdCl_2$ and 0.25mg GAspray. Moreover, highest raise in number of leaves was observed in Desimakai at 0.25mg GAspray.Overall, both verities showed excellent performance but Desimakai performed good as compared to Desimaki. Varietal significant ($p \leq 0.05$) difference was detected between both cultivars as shown in Table.No.5.

Table.No.5: ANOVA table for No. of Leaves of two maize cultivars (Neelam and Desimakai) under $CdCl_2$ stress with foliar application of Gibberellic acid.

Source of variation	df	MS	F-Value	p-value
Stress	1	12.041667	32.111111	.0000 ***
Spray	1	18.375	49	.0000 ***
Varieties	1	9.375	25	.0001 ***

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Stress X Spray	1	9.375	25	.0001 ***
Stress X varieties	1	0.375	1	.3322 ns
Spray X varieties	1	1.0416667	2.7777778	.1150 ns
Stress x spray x varieties	1	0.0416667	0.1111111	.7432 ns
Error	16	0.375		

Non-significant=^{ns}. ***, **, * significant at 0.001, 0.01, 0.05 separately

Leaf Area (cm):

Anova numbers of data for Leaf Area of 2 maize Cultivars (Neelam or Desimakai) grown in control condition and CdCl2 tension. Treatment of Gibberellic acid cause significantly ($p \leq 0.05$) reduced in Leaf area of these two verities Neelam and Desimaki but there was maximum increased in leaf area was observed in both Neelam and Desimakai when 200µm Cadmium chloride was applied. Both Neelam and Desimakai performed better under 200µm $CdCl_2$ and 0.25mg GAspray. Moreover, highest reduced in leaf area was detected in desimakai or Neelam at 0.25mg GAspray as shown in Figure.No.2. Both verities showed poor performance at control. Varietal significant ($p \leq 0.05$) varietal difference was detected between both cultivars.

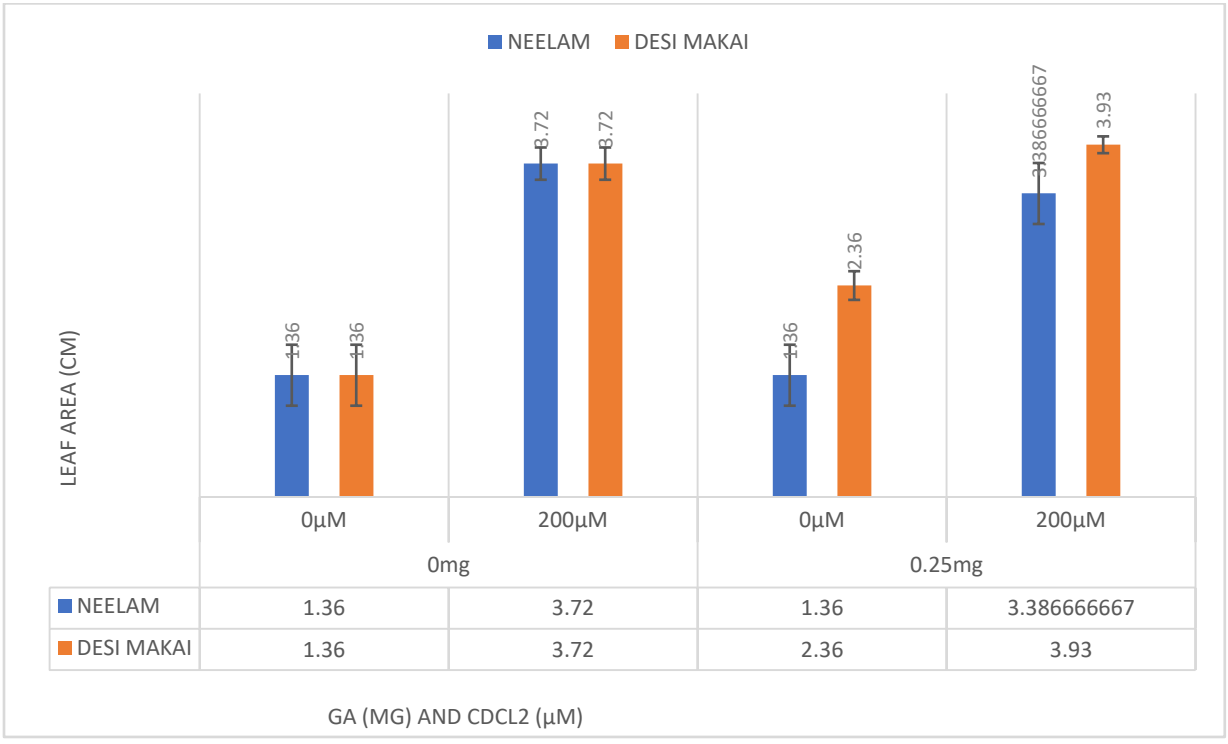

Fig.No.2: Leaf area (cm) of two maize cultivars (Neelam and Desimakai) under $CdCl_2$ stress with foliar application of GA.

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Photosynthetic pigments

Chlorophyll "a" (mg/g fresh weight):

Anova numbers for Chlorophyll a of 2 maize Cultivars (Neelam and Desimakai) grown in control condition and Cadmium chloride tension. Treatment of Gibberellic acid cause significantly ($p \leq 0.05$) improved in Chlorophyll a of Desimaki, and highest decline was detected in chlorophyll a of Desimakai when 200µm Cadmium chloride was applied. Both Neelam and Desimakai performed better beneath control. Moreover, highest improved in chlorophyll a was observed in Desimakai at 0.25mg GAsprayvarietal significant ($p \leq 0.05$ difference was detected between both cultivars as shown in Table.No.6.

Table.No.6: ANOVA table for chlorophyll a of two maize cultivars (Neelam and Desimakai) under $CdCl_2$ stress with foliar application of Gibberellic acid.

Source of variation	df	MS	F-Value	p-value
Stress	1	0.423207	71.847724	.0000 ***
Spray	1	0.485926	82.495508	.0000 ***
Varieties	1	0.740962	125.79289	.0000 ***
Stress X Spray	1	0.354051	60.107132	.0000 ***
Stress X varieties	1	1.892255	321.24753	.0000 ***
Spray X varieties	1	0.012467	2.1165257	.1651 ns
Stress x spray x varieties	1	0.5548	94.188225	.0000 ***
Error	16	0.0058903		

Non-significant=^{ns}. ***, **, * significant at 0.001, 0.01, 0.05 separately

Chlorophyll "b" (mg/g fresh weight):

Anova numbers for Chlorophyll b of 2 maize Cultivars (Neelam and Desimakai) grown in control condition and Cadmium chloride tension. Treatment of Gibberellic acid cause significantly ($p \leq 0.05$)enhanced in chlorophyll b of both NeelamandDesimaki but maximum growth in Chlorophyll b was observed in Desimakai when 200µm Cadmium chloride was applied. On the other hand, maximum increased in chlorophyll b was observed in Desimakai at 0.25mg GAspray and 200µm Cadmium chloride. Varietal significant ($p \leq 0.05$) difference was detected between both cultivars as shown in table.No.7.

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Table.No.7: ANOVA table for chlorophyll b of two maize cultivars (Neelam and Desimakai) under $CdCl_2$ stress with foliar application of Gibberellic acid.

Source of variation	df	MS	F-Value	p-value
Stress	1	0.083426	28.602806	.0001 ***
Spray	1	0.383801	131.58706	.0000 ***
Varieties	1	1.145377	392.69509	.0000 ***
Stress X Spray	1	0.146797	50.329695	.0000 ***
Stress X varieties	1	1.023827	351.0214	.0000 ***
Spray X varieties	1	4.3682134	1497.6518	.0000 ***
Stress x spray x varieties	1	0.062526	21.437194	.0003 ***
Error	16	0.0029167		

Non-significant=^{ns}. ***, **, * significant at 0.001, 0.01, 0.05 separately

Carotenoids (mg/g fresh weight):

Anova numbers for carotenoids of 2 maize Cultivars (Neelam or Desimakai) grown in control condition and CdCl2 tension. Application of Gibberellic acid cause significantly ($p \leq 0.05$) declined in carotenoids of both Neelam and Desimaki, maximum growth was observed in both verities when 200µm Cadmium chloride was applied. On the other hand, maximum increased in both verities was observed at 0.25mg GAspray and 200µm Cadmium chloride. Varietal significant ($p \leq 0.05$) difference was detected between both cultivars as shown in Table.No.8.

Table.No.8: ANOVA table for carotenoids of two maize cultivars (Neelam and Desimakai) under $CdCl_2$ stress with foliar application of Gibberellic acid.

Source of variation	df	MS	F-Value	p-value
Stress	1	70.331243	1405.888	.0000 ***
Spray	1	49.064254	980.7712	.0000 ***
Varieties	1	0.219778	4.393263	.0523 ns
Stress X Spray	1	3.433753	68.63911	.0000 ***
Stress X varieties	1	0.581363	11.621174	.0036 **

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Spray X varieties	1	6.282584	125.5859	.0000 ***
Stress x spray x varieties	1	3.365506	67.27488	.0000 ***
Error	16	0.0500262<-		

Non-significant=^{ns}. ***, **, * significant at 0.001, 0.01, 0.05 separately

Total Chlorophyll (mg/g fresh weight):

Anova numbers for total chlorophyll of 2 maize Cultivars (Neelam and Desimakai) grown in control condition and CdCl2 tension. Treatment of Gibberellic acid cause significantly ($p \leq 0.05$) decline in total chlorophyll of both Neelam orDesimaki, highest decline was detected in total chlorophyll of both verities when 0.25mg GA was applied. On the other hand, maximum increased in total chlorophyll of both verities was observed at 0.25mg GAspray and 200µm Cadmium chloride. Varietal significant ($p \leq 0.05$) difference was detected between both cultivars as shown in Figure.No.3

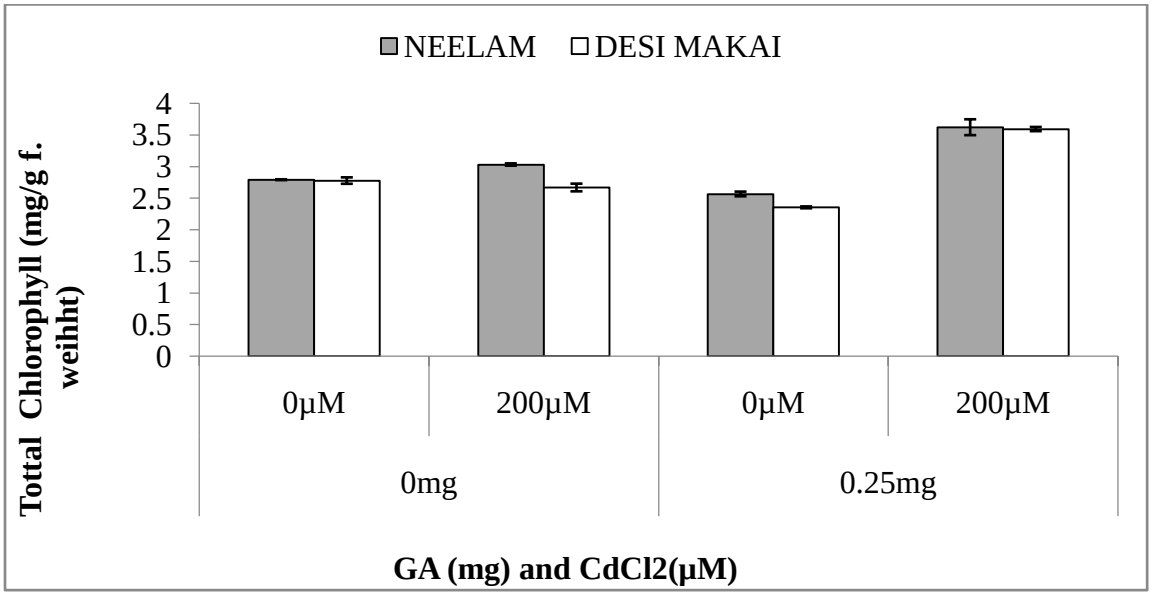

Figure.No.3: Total Chlorophyll (mg/g f. weight) of two maize cultivars (Neelam and Desimakai) under $CdCl_2$ stress with foliar application of GA.

Chlorophyll a and b ratio (mg/g fresh weight):

Anova numbers for Chlorophyll a and b fraction of 2 maize Cultivars (Neelam and Desimakai) grown in control condition and cdCl2 tension. Treatment of Gibberellic acid cause significantly ($p \leq 0.05$) growth in chlorophyll a and b ratio of both Neelam and Desimaki, maximum reduction was observed in the growth of both verities when 200µm Cadmium chloride was applied. On the other hand, maximum increased in both verities was observed at 0.25mg GAspray and Varietal significant ($p \leq 0.05$) difference was detected between both cultivars as shown in Figure.No.4

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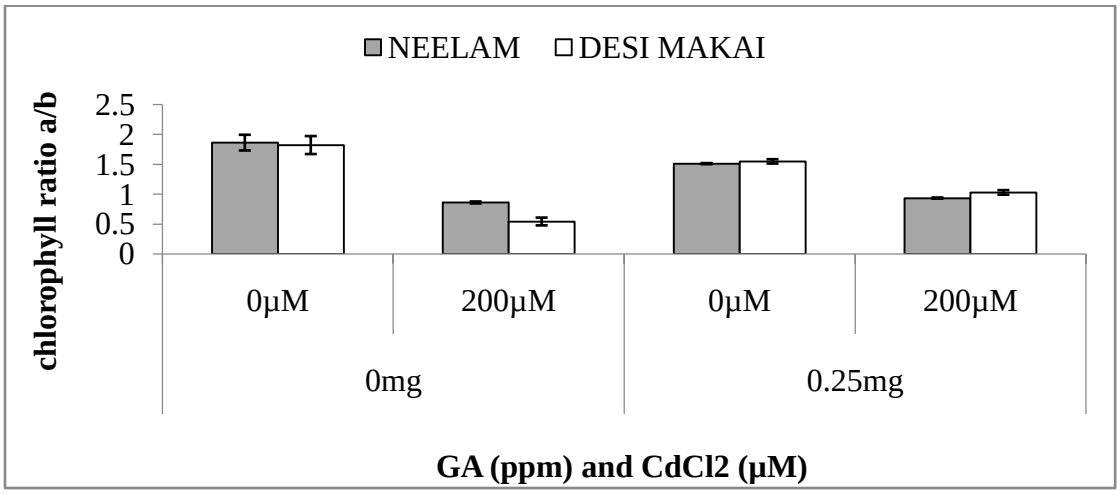

Figure.No.4: chlorophyll ratio a/b of two maize cultivars (Neelam and Desimakai) under $CdCl_2$ stress with foliar application of GA.

Net photosynthetic rate (A) (µmol $m^{-2}s^{-1}$)

Anovanumbers for Net photosynthetic rate of 2 maize Cultivars (Neelam and Desimakai) grown in control condition and CdCl2 tension. Application of Gibberellic acid cause significantly ($p \leq 0.05$) increased inNet photosynthetic rate of Desimaki at 0.25 GA, maximum decreased was observed in the Net photosynthetic rate of both verities when 200µm Cadmium chloride. On the other hand,maximum growth was observed in Neelam and desimakai at 200µm Cadmium chloride and 0.25mg GA. varietal significant ($p \leq 0.05$) difference was detected between both cultivars as given in Figure.No.5.

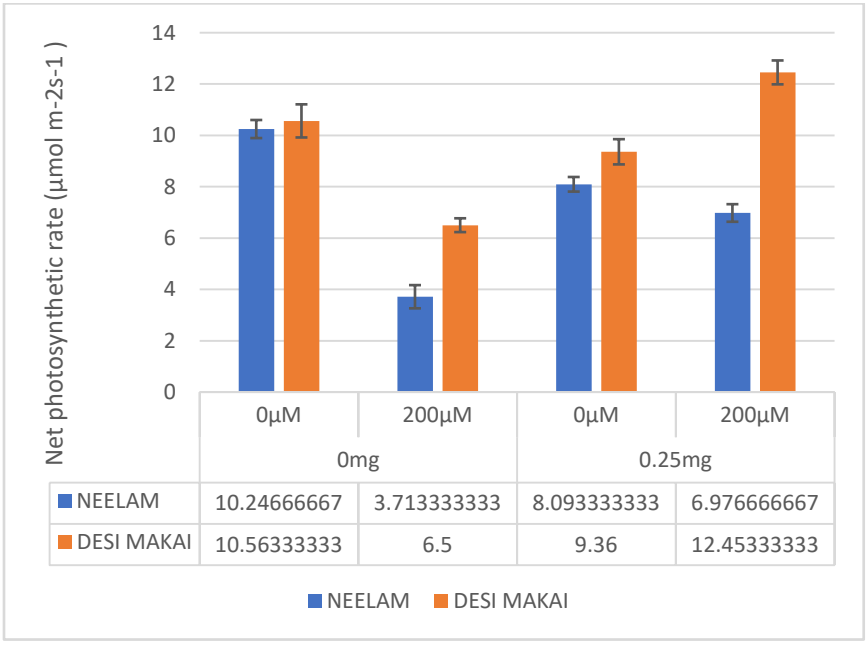

Figure.No.5: Net photosynthetic rate of two maize cultivars (Neelam and Desimakai) under $CdCl_2$ stress with foliar application of GA.

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Transpiration rate (E) (m mol $m^{-2}s^{-1}$):

Anova numbers for transpiration rate of 2 maize Cultivars (Neelam or Desimakai) matured in control environment or CdCl2 tension. Application of Gibberellic acid cause significantly ($p \leq 0.05$)declined inE of both Neelam orDesimaki at 0.25 GA, maximum decreased was observed in the growth of both verities when 200µm Cadmium chloride and 0.25mf GA was applied. On the other hand, maximum growth was observed in Neelam anddesimakai at 200µm Cadmium chloride. Varietal significant ($p \leq 0.05$) difference was detected between both cultivars.

Gas Conductance [Ci] (µ mol mol^{-1})

Anova numbers for gase conductance of 2 maize Cultivars (Neelam and Desimakai) grown in control condition or CdCl2 tension is given in (Fig. 4.18; Tab. 4.18). Treatment of Gibberellic acid cause significantly ($p \leq 0.05$) enhanced ingas conductance of both Neelam and Desimaki at 0.25 GA, but maximum increased was observed in the growth of both verities when 200µm Cadmium chloride was applied was given in (Fig. 4.18). On the other hand, maximum growth was observed in Neelam anddesimakai at 200µm Cadmium chloride. Varietal significant ($p \leq 0.05$) difference was detected between both cultivars. Anova numbers for proteins of 2 maize Cultivars (Neelam or Desimakai) matured in control environment or CdCl2 tension. Application of Gibberellic acid cause significantly ($p \leq 0.05$) enhanced in proteins of both Neelam and Desimaki at 0.25 GA, there were no decreased in growth in both verities. On the other hand, maximum growth was observed in Neelam and desimakai at 200µm Cadmium chloride and 0.25mg GA. Varietal significant ($p \leq 0.05$) difference was detected between both cultivars as shown in Figure.No.6.

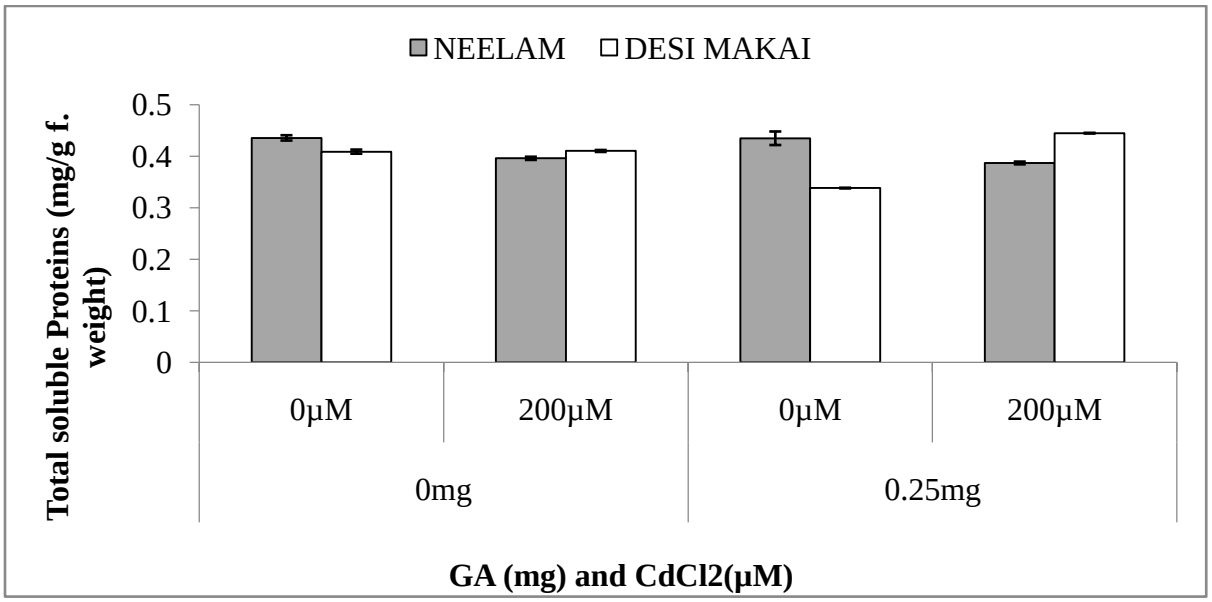

Figure.No.6: Total soluble proteins of two maize cultivars (Neelam and Desimakai) under $CdCl_2$ stress with foliar application of GA.

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Peroxidase (POD) (mg g^{-1} fresh weight)

Anova numbers for pod of 2 maize Cultivars (Neelam or Desimakai) matured in control environment or CdCl2 tension. Application of Gibberellic acid cause significantly ($p \leq 0.05$) enhanced in the pod of both NeelamandDesimaki at 0.25 GA, maximum decreased was observed in the growth of both verities when 200µm Cadmium chloride. On the other hand, maximum growth was observed in Neelam anddesimakai at 200µm Cadmium chloride and 0.25mg GA. Varietal significant ($p \leq 0.05$) difference was detected between both cultivars are given in Figure.No.7.

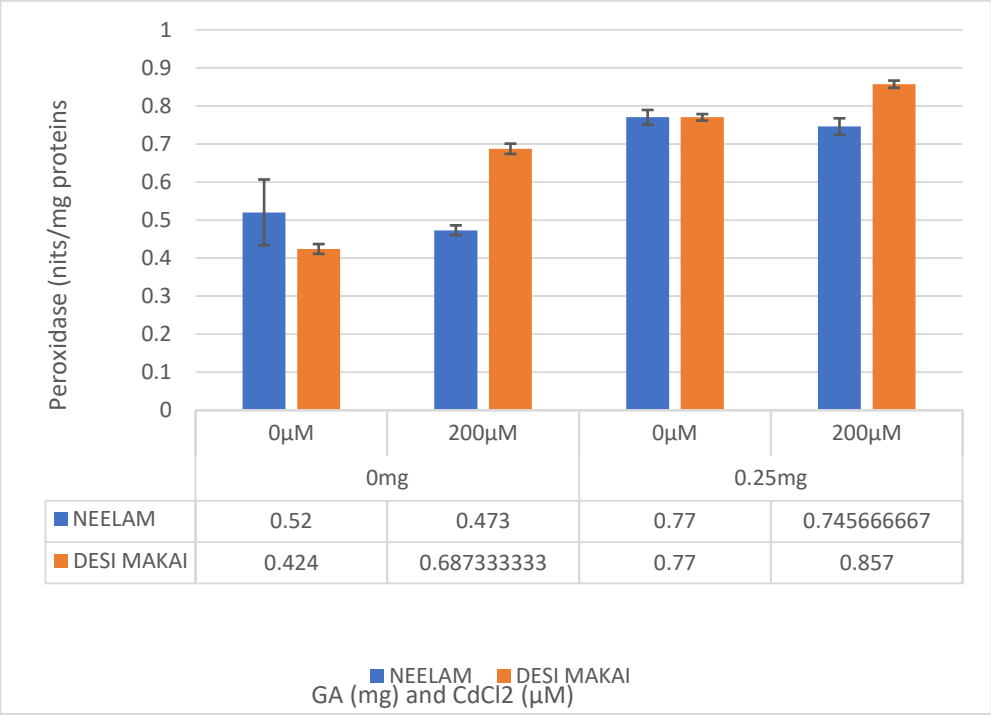

Figure.No.7: Peroxidase of two maize cultivars (Neelam and Desimakai) under $CdCl_2$ stress with foliar application of GA.

DISCUSSION:

Stress of heavy metal is one of the dangerous threats faced by cropping plants often resulting in loss of productivity, delay in expansion and short amount. Cda oxidative hasty metal initiate in small amount in many soil forms. Cd being an unnecessary metal. It is quickly absorbed from plant roots. Higher Cadmium solubility and movement inside the soil organization of plants donate to its toxic effect. Growth, promote necrosis and destruction of chlorophyll, change Nutrient absorption, and carbon uptake [22]. Cadmium can be easily absorbing and accumulates in the tissues of plants where the rhizome is the major place of absorption. At cell level mostly of the major processes identified toxicity. Patience of heavy metals in flora is greater than outcome of diverse process which protect the increase of heavy metals in the plant's cells. These processes are very much necessary for the growth of plants. After Triticumastivum and rice the most important grain crops are corn. Corn grain is used for 3 major uses. An important food stuff

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for farm animals. A greatest food crop for human utilization or rare equipment for a big quantity of engineering use. In our study corn the morphological parameters were increased by using GA and decreased by using Cadmium Chloride. Flora rhizomes are one of the main inclined part of plants to ecological stresses. Rhizomes are the one and only part of plant anchor in the soil or come into sight directly get in touch with heavy metals. These results were matched with [23]. in which the same parameters were decreased by high concentration of cadmium chloride because Cd absorption or dissolves places in rhizomes or the assessment of exploit mechanism of Cd toxic to flora rhizome slant cell or their penalty on mitotic catalog are very important. Cadmium chloride is a heavy metal and it forced harmful effects on metabolic activity and physiological process in plants resulting plants reduced their growth. The outcome at this time indicate that cadmium introduction drastically reserved the mitotic index in rhizome slant bioassay in a amount reliant way. Beneath Cd tension the mitotic index distorted in excellent conformity with the cry from rhizome development [24].Moreover, enlargement of flora is the excellent index for assessing flora retort to ecological stress [25,26]. demonstrated the declined in whole weight of *Phaseolus vulgaris* at what time matured under cadmium chloride stress. The seedlings fresh biomass or dry biomass declined completely with the greatest amounts of Cd interested in the rhizome system. Equally fresh biomass ofjuvenile flora declined whereas dry biomass [27,28]. Moreover, detected the declined in mass of tomato unpaid to cadmium chloride application.Declined in branch mass appropriate to the function of Cd was calculated in *Phaseolusvulgaris,T. aestivum*or in alfalfa by as regards 16.0% as contrasted with branch size of the control cluster. Results clarified branch length is completely affected under the application of cadmium chloride tension of *T. aestivum*presentation ideal unenthusiastic association by means of the growing absorption of cadmium chloride to the rhizome system [29,30]Cadmium distress rhizome increase extra strictly than branch increasehaving estimation that the declined in the rhizome length or tallness of the flora was appropriate to cadmium absorption in *corns* [31,32].He additional demonstrated that such a decline was straight relative by means of the raise of metal amount in flora. The decline in rhizome length below the pressure of cadmium was verification in tomato, *Phaseolus vulgaris*, *Solanummelongena* and alfalfa.

Conclusion:

Corn is very dynamic yield in all over the globe. It contains a great amount of nutrition for humans and animals. It contains carbohydrates, protein and lubricate all these things are necessary in provided that sufficient foodstuff or nourishment in favor of both humans and animals. Carbohydrates of corn have newly turn into a significant rare stuff for the manufacture of ethanol. The most important yield in the globe or in the ground of foodstuff animal feed and bio energy production. Cadmium negatively affects photosynthesis and growth. The significant negative effect of Cd in photosynthesis is due to the inhibition of the synthesis of chlorophyll or low growth. Gibberellins are phytohormones promoting growth. Gibberellins are plant growth regulators released inside the plants by leaves and develop at the peak of root and shoot. It is now clear that federations play central roles in regulating growth, particularly in answer to ecological situation including beam, warmth salt, pressure. Experiment was carried out in Old Botanical Garden to recognize the behavior of Cadmium Chloride ($CdCl_2$) stress. 2 maize (*Zea mays* .L) verities were grown in 24 pots that were separated as treatment and control. Pots were

filled with 8 kg soil and maximum 10 seeds were sown in each pot. $CdCl_2$ stress was applied with different applications (0 and 200µM) when plant reached 3 leaves stage. At the same time foliar GA applied with concentrations (0 and 0.25mg). Foliar application of gibberellic acid at vegetative phase was more beneficial in ameliorating the harmful effect of cadmium chloride stress. It causes significantly increased in most of the parameters. Atlast, it was concluded that DesiMakai performed better then Neelam in both stress and spray conditions.

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