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ORIGINAL RESEARCH ARTICLE

Influence of Mercuric Chloride on Seed Germination, Seedling Growth and Biochemical Analysis of Green Gram (*Vigna radiata* (L.) Wilczek. Var. Vamban-3)

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ABSTRACT

Seedling growth and bio chemical studies of green gram (*Vigna radiata* (L). Wilczek. Vamban -3)The seeds of green gram were obtained from the Regional Research station, Vamban.The seeds of green gram were germinated in different concentrations of (10,25,50, 100 and 200 mgl^{-1}) mercuric Chloride and it was compared with the control plants irrigated with distilled water. The germination parameters like germination percentage root and shoot Length fresh and dry weight of seedlings showed a decreasing trend with increase in mercuric concentration. Bio-Chemical constituents, Photosynthetic pigments, Protein, Sugar and Starch were analyzed on Seventh day. Mercuric treatments at different concentrations were tested and decreased the various growth and biochemical constituents.From the present investigation it was found that the level of mercuric above 200mgl^{-1} proved to be lethal, However the increase in mercury concentrations, (Control 10,25,50,100, 200 mg-1) showed concomitant decrease in all morphological parameters and biochemical constituents, it was also noted that cultivar Vamban-3 able to tolerate the mercury toxicity to a certain extent when compared with the rest of the cultivars taken up for the present study.

Key Ward: *Vigna radiata*,Green gram, Mercury, Seed germination

1. INTRODUCTION

The needs of present day man have increased tremendously in different directions. The human beings depend more and more on plants and their products for their basic fulfillments like nourishment, raiment and tenement to survive successfully. The increasing demand for food production to feed geometrically growing population is of serious concern. Efforts have been directed by agricultural and plant scientists towards modernizing agriculture for higher food production. On one hand, the advancements of science and technology have added to human comfort, while on the other hand they have given us one of the serious problems to face namely, the pollution.Industrial expansion without much awareness of the environment brought with the population and environmental degradation. Industry released toxic substances into soil, water, atmosphere, forest and into the human food chain symbolized by the LOS Angles smog, the proclaimed "death" of the Lake Eris and the progressive pollution of all major rivers of the world [5,6,13].

Heavy metal stress causes multiple direct and indirect effects on all physiological processes of plants [21]. They can create major ecological crisis, since they are conservation in nature. They often accumulate in plant parts and biologically magnified through tropic levels [8]. The primary toxicity mechanism of heavy metals is that they alter the catabolic function of enzymes [4]. Among the myriad of heavy metals, mercury occupies the prominent position since it plays a vital role in the growth and development of plants [17,18].

Mercury ranks twenty fourth in abundance in the earth crust with an average value of70 ppm [11] Mercury ranks fourth among metals of the world in annual consumption behind iron, aluminium and copper [16] Mercury is extensively used as a protective coating on a number of metals to prevent corrosion in alloys such as brass and bronze. Mercury is used in dry batteries, construction materials, pigments, printing processes.Agricultural use of mercuric chloride containing fungicides such as mancozeb (16% Mn and 2% Hg) Zineb and Ziram (1-18% Hg) may be yet another source of mercury in the environment

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[20]. Mercury is a bluish white relatively soft metal, with a density of 7.133g.cm^{-3} with an atomic weight of 80.6, melting point of 419.6^{o}C and boiling point of 907^{o}C.Mercury is one of the essential nutrients of plant for normal growth and development [1,7,9,12]. So mercury is classified as a micronutrient. Mercury is very essential for plant nutrution at low level because, it is vitally involved in a number of metalo enzymes to provide stability to cytoplasm and ribosomes [19,2,3].The pulses have been under cultivation throughout the world since time immemorial. They occupy a significant position among food crops as source of legumes, vegetables, oils, etc., [10,15].

2. MATERIALS AND METHODS

The present investigation was carried out to find the "Efficacy of mercury on germination, seedling growth and biochemical studies of greem gram (*Vigna radiata* (L). Wilczek. Vamban-3)

2.1 SEED MATERIALS

The seeds of green gram (***Vigna radiata (L).*** Wilczek. Vamban-3) was procured from the Regional Rice Research Station, Vamban. The seeds with uniform size, colour and weight were chosen for experimental purpose.

2.2 METAL

Mercuric chloride was dissolved in distilled water and used for the treatment purpose.

2.3 GERMINATION STUDIES

The method of germination was carried out by Top Paper method as recommended by International Seed Testing Association (1976). The green gram seeds were surface sterilized with 0.2% mercuric chloride ($HgCl_2$) for two minutes the seeds were thoroughly washed with tap water. The sterilized seeds were arranged equi-spacially on the periphery of sterilized petri dishes lined with filter paper. Each petri dishs was irrigated uniformly by various concentrations of mercury solution in the respective petri dishes. In addition to these petri dishes containing seeds were irrigated with tap water was maintained as control. Each treatment including control was replicated five times. So that a total of hundred seeds were used for each treatment. All the petri dishes were kept under diffused light at room temperature (28 $\pm$ 2^{o}c). The number of seeds germinated in each treatment was counted on seventh day and germination percentage was calculated. The emergence of radical was taken as a criterion for germination. Ten seedlings from each replica was selected for recording the morphological parameters such as shoot length and root length.

2.4 FRESH AND DRY WEIGHT

The seventh day green gram seedlings were separated into shoot and root. The fresh weight of them was recorded. They were kept in a hot air oven at 80^{o}C for 24 hours. After 24 hours the dry weight of shoot and root were weighed and recorded.

2.5 BIOCHEMICAL ANALYSIS

The seventh day green gram seedlings were separated into root, shoot and leaf and they were used for biochemical analysis (Chlorophyll, protein, sugar and starch) by using the following methods.

- Estimation of chlorophyll: (Arnon, 1949).
- Estimation of protein: (Lowry *et al*., 1951).
- Estimation of reducing sugar: (Nelson – Somogyi's method).
- Estimation of Starch: (Lugol's Iodine method).

3. RESULTS AND DISCUSSION

In the present study, seed germination, seedling growth and biochemical analysis of green gram plant was studied under mercuric chloride stress.

3.1 LABORATORY STUDIES

Germination Percentage

The germination percentage value of green gram under mercuric chloride treatment is presented. The maximum germination was observed in control (96.51). The mercuric chloride concentration increased with decrease in germination land (**Table 1 & plate 1**).

3.2 SEEDLING LENGTH

Root Length (cm/seedling)

The root length was decreased with increased level of mercuric chloride concentration. The maximum root length was observed at untreated plant (6.2) when compared to treated plants. The results obtained from (**Table 2 & plate 2**).

3.3 SHOOT LENGTH (cm/seedling)

Fresh and dry weight (g/seedling)

The seedling fresh and dry weight was recorded in (**Table 3 & Plate 2**). The maximum weight of fresh root and shoot was observed in control plant (0.515) and (0.224g/plant respectively) and weight of dry root and shoot (0.065 and 0.034 g/plant and respectively).

The decreasing level of fresh and dry weight in both root and shoot with increasing level of mercuric chloride concentration.

3.4 BIOCHEMICAL CONSTITUENTS (m/g fr.wt)

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Chlorophyll pigment:

The chlorophyll pigment contents such as chl-a, chl-b and total chlorophyll of mercuric chloride treatment plant was recorded in (**Table 4**). The pigment content decreased with increase in level of mercuric chloride treatment when compared to control. The untreated plant content of chl-a, chl-b and total chlorophyll were recorded as 0.399, 0.371 and 0.770 mg/g ft.wt respectively.

Reducing Sugar (mg/g fr.wt)

Reducing sugar of green gram plant under mercuric chloride stress was represented in (**Table 5**). The reducing sugar of root (3.005), Shoot (3.217) and Leaf (3.575) were recorded in untreated plants. The decreasing level of reducing sugar with increased level of mercuric chloride treatment when compared to control.

Protein (mg/g fr.wt)

The highest protein content of root (2.175), shoot (2.414) and leaf (2.604) were recorded in control Plant, increase in mercuric chloride treatment with decrease in Protein content of all the treatments, the root, shoot and leaf .The results recorded in (**Table 6**) .

Starch (mg/g fr.wt)

The affect of mercuric chloride on Starch content of green gram Seedlings are presented in (**Table 7**). The Starch content was high in leaf than the root and shoot.The maximum starch content was recorded in control Plants such as root (4.48), Shoot (5.273) and leaf (5.615) when compared to treated Plants.

Table 1: Germination percentage of green gram (*vigna radiata. (L.)* Wilczek Var.Vamban -3 Seedlings under mercuric chloride treatment.

Mercuric Level (mgl-1)	Germination Percentage
Control	96.51
10	85.42
25	74.91
50	55.62
100	21.84
200	7.36

Table 2 :Effect of mercuric on root length and Shoot Length (cm/plant-1) of green gram (*vigna radiata (L.)* Wilczek. Var. Vamban-3) seedlings.

Mercuric Level (mgl^{-1})	Root Length	Shoot Length
Control	6.2± 0.12	21.5± 0.15
10	5.9±0.15	19.3±0.19
25	4.5±0.22	14.1±0.32
50	4.1±0.19	12.6±0.19
100	3.9±0.16	9.5±0.15
200	1.5±0.02	7.1±0.07

Table 3: Effect of mercuric on fresh weight and dry weight of root and shoot (g / $Plant^{-1}$) of green gram (*vigna radiata (L.)* Wilczek. Var. Vamban -3) Seedlings.

Mercuric level (mgl^{-1})	Root		Shoot	
	Fr.Wt	Dry.Wt	Fr.Wt	Dry.Wt
Control	0.527 ±0.01	0.078 ±0.01	0.256 ±0.02	0.046 ±0.01
10	0.515 ±0.05	0.065 ±0.01	0.224 ±0.02	0.034 ±0.01
25	0.496 ±0.02	0.057 ±0.01	0.215 ±0.02	0.027 ±0.02
50	0.475 ±0.01	0.048 ±0.02	0.196 ±0.01	0.022 ±0.01
100	0.427 ±0.02	0.041 ±0.01	0.164 ±0.00	0.019 ±0.01
200	0.281 ±0.01	0.029 ±0.01	0.141 ±0.00	0.016 +0.01

Table 4: Photo synthetic pigments content (mg/g fr.wt) of green gram (*Vigna radiata* (L.) Wilczek Var. Vamban-3) seedling under mercury treatment.

Mercuric level (mgl^{-1})	Chl 'a'	Chl 'b'	Total Chl
Control	0.399±0.001	0.371±0.009	0.770±0.011
10	0.362±0.003	0.381±0.007	0.743±0.006
25	0.315±0.012	0.347±0.002	0.662±0.005
50	0.287±0.006	0.264±0.006	0.551±0.010
100	0.227±0.005	0.215±0.005	0.442±0.011
200	0.196±0.001	0.174±0.003	0.370±0.008

Table 5: Efficacy of mercuric on reducing content (mg/g^{-1} fr. Wt.) of green gram (*Vigna radiata* .(L) . Wilczek. Var. Vamban-3)

Mercury level (mgl^{-1})	Root (mg)	Shoot (mg)	Leaf (mg)
Control	3.005±0.15	3.217±0.06	3.515±0.02
10	2.827±0.13	2.915±0.09	3.306±0.03
25	2.652±0.12	2.876±0.05	3.105±0.06
50	2.171±0.09	2.446±0.01	2.875±0.01
100	1.946±0.11	2.205±0.03	2.546±0.03
200	1.527±0.07	1.737±0.07	2.006±0.02

Table 6: Influence of mercuric on protein content (mg/g^{-1} fr. Wt.) of green gram (*Vigna radiata* .(L) . Wilczek. Var. Vamban-3)

Mercuric level (mgl^{-1})	Root (mg)	Shoot (mg)	Leaf (mg)
Control	2.175±0.07	2.472±0.09	2.604±0.09
10	2.603±0.05	2.276±0.07	2.411±0.08
25	1.875±0.02	2.007±0.06	2.135±0.01
50	1.622±0.02	1.915±0.07	2.068±0.02
100	1.361±0.04	1.510±0.08	1.732±0.04
200	0.927±0.03	1.273±0.04	1.419±0.07

Table 7: Influence of mercuric on Starch content (mg g^{-1} fr. Wt) of green gram (*Vigna radiata* .(L) Wilczek .var. Vamban-3).

Mercuric level(mgl^{-1})	Root(mg)	Shoot (mg)	Leaf(mg)
Control	4.821 ± 0.211	5.273 ± 0.22	5.618 ± 0.21
10	4.377 ± 0.19	4.562 ± 0.21	4.782 ± 0.19
25	3.925 ± 0.17	4.271 ± 0.15	4.430 ± 0.15
50	3.432 ± 0.32	3.715 ± 0.11	4.114 ± 0.14
100	3.117 ± 0.14	3.306 ±0.09	3.932 ± 0.21
200	2.356 ± 0.11	2.714 ± 0.13	3.095 ± 0.06

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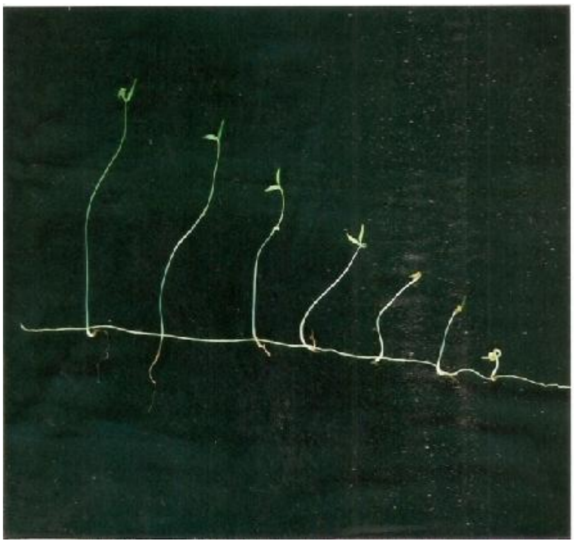
Photographs exposing the effect of mercury on germination and early seedling growth of green gram (*vigna radiata.* (L.) Wilczek. Var. vamban – 3)

Plate - 1

Plate - 2



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