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REGULAR ARTICLE

EFFECT OF CHROMIUM ON GROWTH AND YIELD OF *VIGNA MUNGO* (L.)

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ABSTRACT

This study was conducted to find out the effect of different concentrations (control 5, 10, 25, 50, 100 and 200 mg/l) of chromium on growth, yield of black gram (*Vigna mungo* L.). Pot culture experiments were carried out with black gram seeds with different concentrations of chromium solution. The morphological growth parameters were recorded at 15, 30, 45 and 60 d old chromium treated plants. The yield was recorded at the time of harvest. The study revealed that, the increase in chromium reduce the growth and yield in black gram plants.

Keywords: Chromium, Morphological, Biochemical, Yield, Blackgram

INTRODUCTION

Rapid industrialization has contributed all kinds of pollution in the environment including water pollution due to discharge of untreated industrial effluent containing heavy metals [1]. These heavy metal contaminated polluted water is being used for the irrigation in some dry areas. Heavy metal pollution has become very acute and is considered to be hazardous [2]. Among the heavy metals, chromium plays a major role in polluting the environment. There are two predominant forms of chromium, namely trivalent and hexavalent chromium. The wastewater released from chemical industries, chrome plating, textile, dye manufacturing, ink and pigment units, photographic material plants contained hexavalent chromium [3].

In India there are more than 2,500 tanneries in India with an annual processing capability of 5, 00,000 tonnes of hides and skin per year. About 80% of tanneries use chromium to the extent of 40,000 tonnes per year and about 15,000 tonnes go as waste in water streams [4]. In addition to leather tannery, there are many industries which contribute heavy metal pollution [5]. Numerous works have already been made on the impact of chromium on various plants under laboratory conditions [6-8]. But, the research work of chromium on growth and yield response of crops is very meagre. Black gram is one among the important legume crop cultivated throughout India [9]. So, an attempt has been made to examine the impact of various concentrations of chromium on growth, and yield parameters of blackgram (*Vigna mungo* L.) through pot culture experiments.

MATERIALS AND METHODS

The seeds of blackgram (*Vigna mungo* L.) were procured from Tamilnadu Agriculture Rice Research Institute, Aduthurai, Tanjore district of Tamilnadu. The earthen pots were lined with polythene sheets and filled with 5 kg of well mixed garden soil. The seeds were surface sterilized with 0.2% HgCl₂ solution and they were sown in the pots. The different concentrations (10, 25, 50, 100 and 200 mg/l) of chromium were prepared from stock solution and used for irrigation. The set irrigated with bore-well water is treated as control. The experiment was replicated 3 times including control. The plant samples were collected at 15, 30, 45 and 60 d after sowing and they were used for recording the various morphological growth parameters viz., plant height, total leaf area [10] and plant dry weight. The yield parameters such as number of pods per plant, number of seeds per pod and 100 seed weight were also recorded at the end of the experiment.

RESULTS AND DISCUSSION

The effect of different concentrations of chromium on plant height, total leaf area and plant dry weight of blackgram were recorded at 15, 30, 45 and 60 d after sowing (table 1). In this pot culture experiment, the maximum growth of black gram plants was observed at control plants and the minimum growth was observed at 200 mg/l chromium concentrations. The increase in chromium concentrations decreased all morphological growth parameters at all the sampling days. The reduction in growth parameters was observed from 5 mg/l concentration onwards. But 5 mg/l concentrations treated plants got higher results between the treatments. Similar findings were noted in various crops such as pea [11-13],

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cowpea [14] and tomato and brinjal [15]. The decreased root growth in higher concentrations of chromium treated plant may be due to inability of cells to divide or expand under heavy metal toxicity [16].

The reduction in plant growth may also be due to the formation of complex between metal and protein which inhibits protein synthesis and ultimately restricts the plant growth [17]. The decline in fresh weight and dry weight of plants at later stages of its growth is mainly due to the senescence of leaves. Further, the decline in fresh weight and dry weight of plants mainly due to degradation of root as well as reduction of new root formation [14]. There was a decrease in total leaf area under chromium irrigation. This may be due to reduction in cell size [15]. Vazques *et al.* [18]

also states that the variation in size of areoles is another feature which was markedly affected by different concentrations of chromium. The size of the areoles decreased in plants treated with chromium and this may be due to the decrease in the leaf area.

The yield of blackgram under chromium stress were shown in table 3. A gradual decline in all the yield parameters were observed at higher chromium concentrations. Similar findings of reduction in yield was observed in earlier reports [12, 13, 19]. It is also reported that the negative effect of yield and dry matter is essentially an indirect effect of chromium on plants higher concentrations of chromium reduced the growth and yield of blackgram as chromium is toxic to plants even a lower concentration.

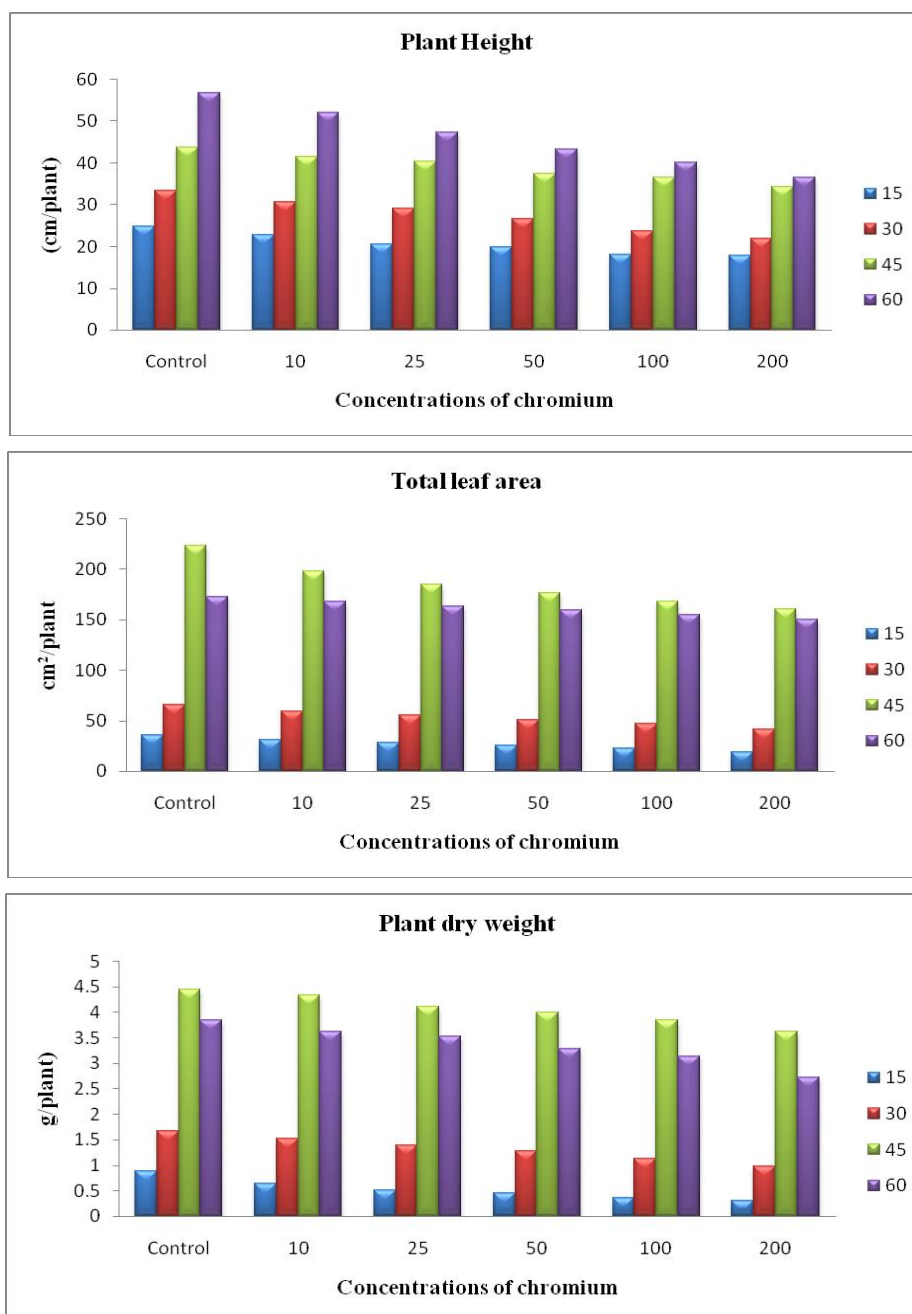


Fig. 1: Effect of different concentrations of chromium on plant height (cm/plant), total leaf area (cm²/plant) and plant dry weight (g/plant) of Blackgram (*Vigna mungo* L.) at different stages of its growth

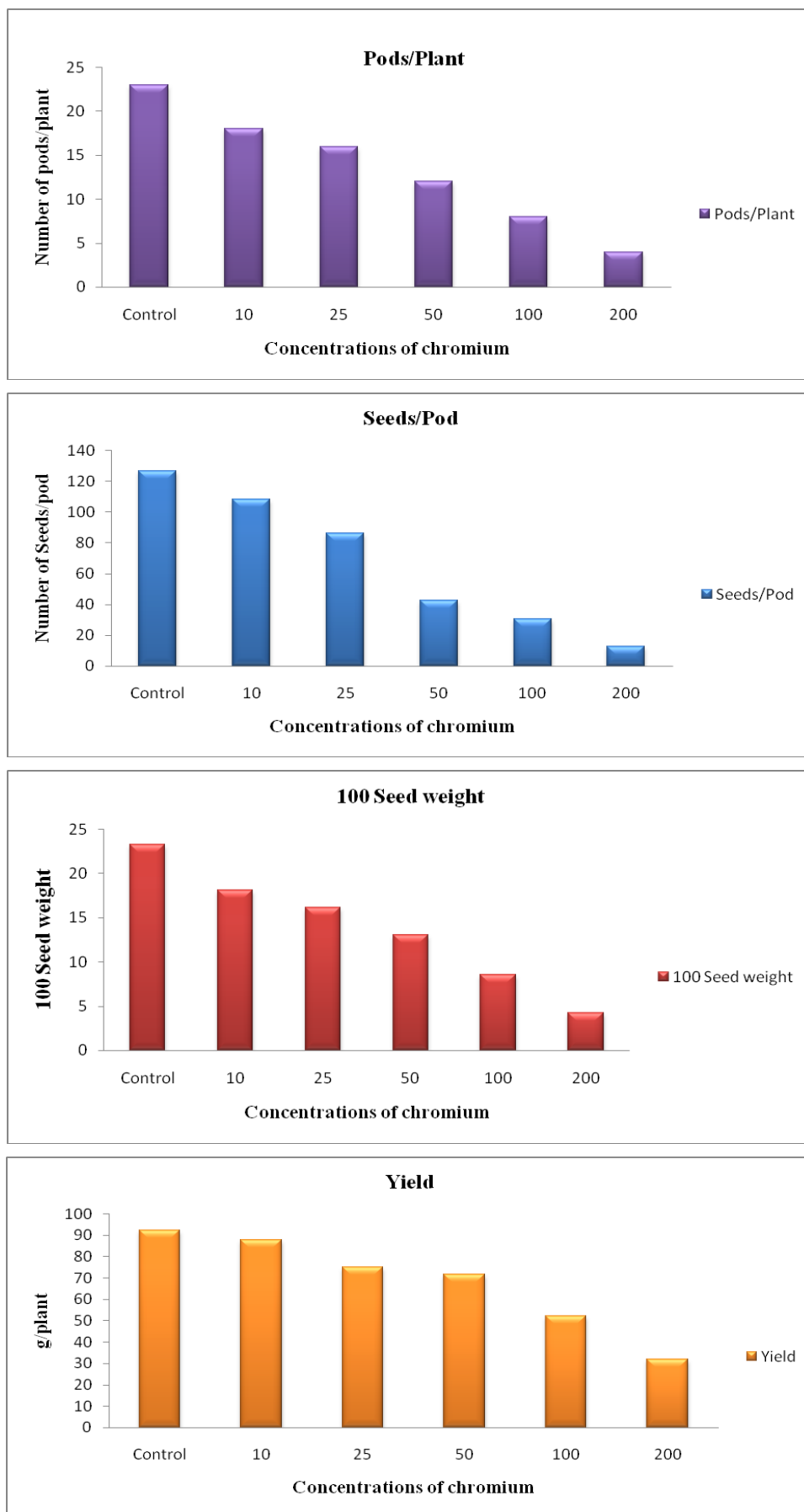


Fig. 2: Effect of different concentrations of chromium on yield parameters of Blackgram, (*Vigna mungo* L.)

Table 1: Effect of different concentrations of chromium on plant height (cm/plant), total leaf area (cm²/plant) and plant dry weight (g/plant) of blackgram (*Vigna mungo* L.) at different stages of its growth

Chromium concentrations (mg/l)	Age of the plant in days											
	15			30			45			60		
	Plant height	Total leaf area	Plant dry weight	Plant height	Total leaf area	Plant dry weight	Plant height	Total leaf area	Plant dry weight	Plant height	Total leaf area	Plant dry weight
Control	24.7 ±0.93	35.5 ± 1.775	0.8864 ± 0.035	33.3 ±1.332	65.8 ± 3.290	1.666 ± 0.083	43.8 ±1.752	223.2 ± 11.160	4.453 ± 0.178	56.7 ±2.83	172.5 ± 8.625	3.850 ± 0.192
10	22.8 ±1.14	31.2 ± 1.560	0.6378 ± 0.019	30.6 ±1.53	59.7 ± 2.985	1.528 ± 0.076	41.4 ±1.987	198.5 ± 9.925	4.344 ± 0.217	52.7 ±2.63	168.2 ± 8.410	3.628 ± 0.181
25	20.5 ±0.82	28.4 ± 1.402	0.5186 ± 0.025	29.0 ±0.92	55.1 ± 2.755	1.400 ± 0.070	40.3 ±2.015	185.2 ± 9.260	4.110 ± 0.205	47.4 ±1.89	163.8 ± 8.190	3.534 ± 0.176
50	19.8 ±0.99	25.6 ± 1.250	0.4531 ± 0.022	26.6 ±1.33	50.8 ± 2.540	1.284 ± 0.064	37.5 ±1.875	176.8 ± 8.840	3.995 ± 0.199	43.3 ±1.73	159.5 ± 7.975	3.294 ± 0.164
100	18.1 ±0.90	22.5 ± 1.125	0.3580 ± 0.017	23.7 ±1.18	46.8 ± 2.320	1.126 ± 0.056	36.4 ±1.820	168.2 ± 8.410	3.853 ± 0.192	40.0 ±2.20	155.4 ± 7.770	3.138 ± 0.156
200	17.9 ±0.89	19.1 ± 0.955	0.3061 ± 0.015	21.8 ±1.09	41.2 ± 2.060	0.980 ± 0.049	34.3 ±1.715	160.2 ± 8.010	3.621 ± 0.181	36.6 ±1.83	150.7 ± 7.535	2.733 ± 0.136

± Standard deviation

Table 2: Effect of different concentrations of chromium on yield parameters of blackgram (*Vigna mungo* (L.) Hepper)

Chromium concentrations (mg l ⁻¹)	Yield parameters			
	Number of pods/plant	Number of seeds/pod	100 seed weight	Yield (g/plant)
Control	23.0 ± 1.15	126.5 ± 6.32	23.28 ± 1.16	92.25 ± 14.61
10	18.0 ± 0.9	108.2 ± 5.41	18.16 ± 0.90	87.8 ± 4.39
25	16.0 ± 0.8	86.0 ± 4.30	16.15 ± 0.80	75.2 ± 3.76
50	12.0 ± 0.6	42.50 ± 2.12	13.01 ± 0.65	71.7 ± 3.58
100	8.0 ± 0.40	30.60 ± 1.53	8.60 ± 0.43	52.12 ± 2.60
200	4.0 ± 0.20	12.80 ± 0.64	4.28 ± 0.21	32.0 ± 1.60

± Standard deviation

CONCLUSION

From this study, it is concluded that the higher concept of Chromium reduced the growth and yield of Blackgram low concentration. It should be removed from the irrigated water. The industrial wastewaters with heavy metals should be treated fully before they discharged into the environment. Both the government and the industries should involve themselves in the environmental protection.

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