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Impact of Cadmium on Germination and Seedling Growth of Carrot (Daucus Carota)

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ABSTRACT

An attempt has ben made to assess the response of carrot under the influence of cadmium with special reference to seed germination and seedling growth. Cadmium was applied in the for of cadmium-chloride ($CdCl_2 2.5H_2O$). Various concentrations of cadmium (00.5,10,25,50,75 and 100 mg/l) were prepared and used for germination studies. It is evident from the results obtained that the increase in cadmium concentration affected all the growth parameters, such as germination percentage, length of root and shoot, fresh weight of root and shoot, vigour index and tolerance index.

INTRODUCTION

The major environmental problems crop out from waste disposal, either from water pollutants. Friberg et al (1974) observed that these pollutants had a high concentration of heavy metals. Heavy metals have been increasing in the environment from industrial waste, agricultural runoff and mining activities. Many of these metals have direct bearing on various physiological and biochemical processes including reduction in growth, photosynthesis, chlorophyll content, inhibition of enzyme activities and degeneration of chloroplast and mitochondria. Heavy metal stress causes multiple direct and indirect effects on all physiological processes in plants. In investigation on the metal toxicity in plants, it is very difficult to distinguish between the primary effects and secondary changes (Wool house, 1983). Cadmium is one of the toxic heavy metals which has many deleterious biological effects (Nriagu, 1980).

They are quite often used as alloys in electroplating, auto industries as stabilizers in polyvinyl chloride (PVC), plastics and in batteries. Cadmium at higher concentrations in soil may impose health hazards to plants and animals. This promoted our interest to explore the effects of different concentrations of cadmium on germination and seedling growth of daucus carota.

MATERIALS AND METHODS

The germination was carried out as per top paper method recommended by International ment testing association (1976). Various concentrations of cadmium chloride solution namely 0, 5, 10,25, 50, 75 and 100 mg/l were prepared and used for the germination studies.

The seeds of daucus carota were obtained Seed Market of Saharanpur (UP). Healthy seeds were selected and surface sterilized with per cent mercuric chloride solution for 2 minutes and washed thoroughly with tap water and then distilled water.

Twenty seeds were evenly placed in each petridishes. They were irrigated uniformly by various concentrations of the cadmium chloride solution in the respective petridishes. One set was irrigated with distilled water (control). All the petridishes were kept under diffused light at room tempera ture (28 ± 2°C). Five replications were maintained for each concentration.

The germination percent age was recorded. The germination percentage was recorded. The emergence of radical was taken as a criterion for germination. Ten seedlings from each replicate was selected for recording the morphometrical parameters such as length of root and shoot, fresh weight of root and shoot, vigour index and tolerance index. They were recorded on the 10^{th} day after germination.

RESULT AND DISCUSSION

It is evident from the Table 1. The germination percentage and vigour index in the control was found to be maximum and gradually decreased with the increase of cadmium chloride concentration. Tolerance index of carrot seedlings gradually decreased with the increase of cadmium chloride concentration. The reduction on germination percentage of carrot may be attributed to the interference of cadmium ions which may inhibit seed germination by exerting a deleterious effect on the activities of hydrolytic enzymes involved in the mobilization of major seed reservoirs (Dua

and Sawhney, 1994). Similar observations were recorded by Kalita et. al. (1993) while studying the effect of cadmium on *Triticum aestivum*. The same pattern of response was noticed in the case of *Vigna unguiculata* L. due to chromium treatment by Lalitha et.al. (2009).

The morphological parameters such as root length and shoot length showed a decreasing trend with increase of cadmium chloride concentration. This is in consonance with the earlier report of Lata (2008) while working on the effect of cadmium on Cucurbita seedlings.

The fresh weight of Carrot seedlings showed a similar trend. The reduction in fresh weight due to cadmium treatment may be attributed to the decreased metabolic rate and reduced transport from the cotyledons, at the same time it may also due to the higher rate of leakage in the membrane permeability. This is in consonance with the earlier reports of (Kalita, et. al. 2003) in the case of *Triticum aestivum* and Bilashouri and Prameeladevi (2005) while working on the effect on zinc on *Vigna radiata* and *Sorghum bicolour*. Similar observations were also recorded by Mahalaksmi and Vijayarengan, (2003) in three plant species. The present investigation reveals that the various concentrations of cadmium has drastic effects on germination and early growth. The growth of the crop plants has been highly reduced at higher concentrations. The concentration above 100 mg/1 has proved to be lethal to the crop.

Table 1: Effect of cadmium on germination, growth, fresh weight, vigour index and tolerance index of daucus carota

Cadmium concentration mg/l	Germination percentage	Root length (cm)	Shoot length (cm)	Root fresh weight (g/plant	Shoot fresh weight (g/plant	Vigour index	Tolerance Index
0	99	6.6	8.8	0.33	0.168	1430.0	
5	93 (-6.1)	5.8 (-7.6)	8.2 (-6.8)	0.28 (-28.2)	0.161 (-2.4)	1238.8 (-13.0)	0.9348
10	84 (-14.3)	4.6 (-25.2)	6.6 (-20.6)	0.24 (-34.12)	0.150 (-6.24)	984.2 (-38.70)	0.7820
25	79 (-20.2)	4.4 (-31.3)	6.2 (-23.3)	0.22 (-37.5)	0.153 (-7.2)	888 (-42.6)	0.6843
50	72 (-28.3)	4.2 (-32.6)	5.2 (-25.3)	0.20 (-37.3)	0.148 (-11.6)	790.4 (-43.5)	0.6326
75	68 (-32.8)	3.4 (-51.3)	5.8 (-34.6)	0.18 (-50.2)	0.144 (-14.3)	579.3 (-62.9)	0.4642
100	56 (-41.8)	2.6 (-62.4)	3.6 (-58.4)	0.16 (-53.2)	0.086 (-48.2)	342.8 (-78.3)	0.3362

(Percent over control values are given in parentheses)

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