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Effect of Different Cadmium Concentrations on Seed Germination of *Ocimum basilicum* L. (Sweet Basil)

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ABSTRACT

Cadmium is one of the harmful heavy metal, which causes significant influences in the process of seed germination. The present study evaluated the influence of different cadmium concentrations viz 20, 40, 60, 80 & 100 mg/litre of double distilled water, on seed germination percentage, seedling vigour index and plumule & radicle length of *Ocimum basilicum* L. seedling. The results indicated that increase in level of cadmium concentration, causes significant reduction in seed germination percentage, seedling vigour index and plumule & radicle length of *Ocimum basilicum* L. seedling as compared to control.

Keywords: Heavy Metals, Cadmium, Germination, *Ocimum basilicum* L., Seedling.

I. INTRODUCTION

Crop production is directly depends on water and soil quality, it is necessary for good crop productivity. Contamination of water by heavy metals is a matter of concern; because it will causes various adverse effects on food quality and environmental health. Cadmium (Cd) is a very strong phytotoxic heavy metal, it is commonly released into the soil from industrial processes and farming practices. Even at low concentrations, it is toxic for plants, while at concentrations greater than 5-10 µg Cd g^{-1} leaf dry weight it leads to plant death **(White and Brown 2010).** Cadmium (Cd), being a highly toxic metal pollutant of soil, inhibits root, shoot growth and yield, affects nutrient uptake and homeostasis, and is commonly accumulated by agriculturally important crops **(Di Toppi et al., 1999).** The germination of seeds is an important stage of whole plant circle; it is also the most sensitive stage of plants **(Liu et al., 2011).** It is important to check the inhibition of plants exposed to contaminants in this stage; it is the best way to understand the toxic mechanisms of environmental contaminants to different plants.

Sweet basil (*Ocimum basilicum* L.) is one of the major essential oil producing species belonging to the family Lamiaceae **(Grayer et al., 1996).** Basil is an economically and industrially important plant **(Sangwan et al., 2001).** It is used as flavouring agent in foods and beverages, as fragrances, as fungicides, or insecticides and in various pharmaceutical and industrial products **(Grayer et al., 1996).**Therefore the study aims to evaluate the effect of different cadmium concentrations on seed germination percentage, seedling vigour index and plumule & radicle length of *Ocimum basilicum* L. seedling.

II. MATERIALS & METHODS

Ocimum basilicum L. CIM-Saumya seeds were collected from Central Institute of Medicinal & Aromatic Plants, Lucknow. Seeds were surface sterilized using 0.5% Mercuric Chloride for 10 min, and then washed in sterilized double distilled water for three times. Seeds with similar size were cultured in petridishes on filter paper to germinate at 25 ºC room temperature. The filter paper was moistened with 10 ml of water, contained cadmium concentrations of 20, 40, 60, 80, 100 mg/L and double

distilled water was used for control. Each petridish had 30 seeds with three replicates. The treatment solution was replaced every day. Germination of seeds was recorded every day and germination percentage, seedling vigour index were then calculated after seeds were germinated for 7 days. Seeds of each treatment were also sampled for the determination of the plumule and radical length. Germination percentage and seedling vigour index were calculated using the following formulas:

Germination percentage = total number of seeds germinated/total number of seeds in all replicates× 100

Seedling vigour index = germination (%) × average seedling length

III. RESULTS & DISCUSSION

The effect of the different concentrations of cadmium on sweet basil, seed germination percentage was presented in (**Table 1**). There was a reduction in seed germination percentage in 40, 60, 80 & 100 mg/L cadmium concentrations in comparison to control. Similarly the reduction was observed in seedling vigour index and plumule & radical length in 40, 60, 80 & 100 mg/L cadmium concentrations in comparison to control. The results of the present study revealed that Cadmium adversely influenced the seed germination. When the concentration of metals exceeded certain levels, an abnormal germination was observed. Cadmium also significantly decreases the seedling vigour index and plumule & radical length in all the treatments (**Table 2, 3 & 4**). Low cadmium concentration 20 mg/L was able to enhance the seed germination, seedling vigour index and plumule & radical length of seeds. (**Claire et al., 1991)** also observed similar results in a study using nickel and other heavy metals on cabbage, lettuce, millet, radish, turnip, and wheat. The statistical analysis was carried out using ANOVA to determine differences among treatment groups for germination percentage and plumule & radical length of *Ocimum basilicum* L. seedlings.

Table 1.	Effect of Cadmium on Seed Germination Percentage of *Ocimum basilicum* L. (Sweet Basil) Seedlings						
Treatments	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**
Control	0.000	0.000	33.333	60.000	76.667	80.000	80.000
Cadmium 20 mg/litre	0.000	0.000	36.667	63.333	70.000	80.000	80.000
Cadmium 40 mg/litre	0.000	0.000	26.667	36.667	56.667	70.000	70.000
Cadmium 60 mg/litre	0.000	0.000	16.667	30.000	46.667	50.000	53.333
Cadmium 80 mg/litre	0.000	0.000	10.000	20.000	26.667	33.333	40.000
Cadmium 100 mg/litre	0.000	0.000	6.667	16.667	26.667	30.000	33.333
C.D. 5%	_	_	**9.376**	**7.263**	**9.376**	**4.193**	**5.930**
C.D. 1%	_	_	**13.145**	**10.182**	**13.145**	**5.878**	**8.313**

Table 2.	Effect of Cadmium on Plumule Length (cm) of *Ocimum basilicum* L. (Sweet Basil) Seedlings						
Treatments	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**
Control	0.000	0.000	0.500	0.967	1.900	2.067	2.167
Cadmium 20 mg/litre	0.000	0.000	0.433	1.000	2.200	2.467	2.600
Cadmium 40 mg/litre	0.000	0.000	0.167	0.500	0.967	1.400	1.933
Cadmium 60 mg/litre	0.000	0.000	0.267	0.467	0.767	0.967	1.400
Cadmium 80 mg/litre	0.000	0.000	0.100	0.267	0.433	0.733	0.967
Cadmium 100 mg/litre	0.000	0.000	0.100	0.233	0.533	0.800	0.967
C.D. 5%	**0.000**	**0.000**	**0.103**	**0.111**	**0.133**	**0.197**	**0.151**
C.D. 1%	**0.000**	**0.000**	**0.144**	**0.156**	**0.186**	**0.276**	**0.212**

Table 3.	Effect of Cadmium on Radicle Length (cm) of *Ocimum basilicum* L. (Sweet Basil) Seedlings						
Treatments	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**
Control	0.000	0.000	0.533	0.967	1.833	2.300	2.867
Cadmium 20 mg/litre	0.000	0.000	0.500	1.000	2.000	2.767	2.967
Cadmium 40 mg/litre	0.000	0.000	0.467	1.000	1.400	2.000	2.433
Cadmium 60 mg/litre	0.000	0.000	0.367	0.933	1.433	2.000	2.433
Cadmium 80 mg/litre	0.000	0.000	0.467	0.867	1.533	2.000	2.467
Cadmium 100 mg/litre	0.000	0.000	0.133	0.200	0.333	0.500	0.667
C.D. 5%	**0.000**	**0.000**	**0.188**	**0.262**	**0.444**	**0.647**	**0.853**
C.D. 1%	**0.000**	**0.000**	**0.263**	**0.367**	**0.622**	**0.907**	**1.196**

Table 4.	Effect of Cadmium on Seedling Vigour Index of *Ocimum basilicum* L. (Sweet Basil) Seedlings
Treatments	**After 7 days**
Control	402.72
Cadmium 20 mg/litre	445.36
Cadmium 40 mg/litre	305.62
Cadmium 60 mg/litre	204.42
Cadmium 80 mg/litre	137.36
Cadmium 100 mg/litre	54.466

IV. CONCLUSION

The results suggested that cadmium seriously affected the germination, seedling vigour index and plumule & radical length in higher concentrations. The lesser concentration was able to enhance the germination of *Ocimum basilicum* L. seeds. The overall study suggested that seed was able to tolerate with the small amount of cadmium concentration and if the concentration is high, it alters the process of germination in *Ocimum basilicum* L. seeds.

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