

Original Research Article

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## Incubation Study of Cadmium with and without FYM at Various Day Intervals

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### ABSTRACT

#### Keywords

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Incubation experiment was carried out to study the effect of cadmium (Cd) and farm yard manure (FYM) on DTPA- Cd at 0, 7, 14, 21, 28, 35 and 42 days after incubation to know DTPA extractable Cd of soil. At Department of Agricultural Chemistry and Soil Science, BACA, AAU, Anand with five levels of Cd (0, 10, 20, 40 and 80 mg kg<sup>-1</sup>) and two levels of FYM (0 and 1 %) on loamy sand (*Typic Ustrochrepts*) soil. The experiment was laid out in a CRD (factorial) with three replications. In incubation study, DTPA- cadmium was reduced at each level of cadmium with advanced in incubation period. The maximum reduction in DTPA-cadmium content was observed in highest level of cadmium at 42<sup>nd</sup> day over 0 day. The FYM application @ 1% showed fixation of cadmium over no FYM application.

### Introduction

Increased world population along with modern industrialization and urbanization had led continuous disposal of sewage and industrial wastes coupled with heavy use of phosphatic fertilizers leads to accumulation of heavy metal, especially cadmium in soils. Unfortunately, sludges, along with nutrients, also contain appreciable amount of heavy metals that persist in surface soils long after application so that soil gets contaminated with pollutant heavy metals. The increasing levels of cadmium in agriculture soils pose potential cadmium toxicity to plants, animals and human population (Tiller, 1986; Alloway,

1995). The cadmium as non-essential element is taken up through the roots of many species and accumulated in all plant parts including root, shoot, fruit and grain (Page *et al.*, 1981). Taken up in excess, cadmium becomes poisonous and can cause serious health hazards to most living organisms (Jackson and Alloway, 1992).

Accumulation of Cd in human body causes several diseases like pain in bones with pathological fracture, wadding gaits, aminoaciduria, Osteomalacia, hyper-tension, liver cancer, pulmonary disease and emphysema. In Japan itaitai disease in human was reported due to Cd toxicity.

In India Cd toxicity has also been reported from rice growing areas and other agricultural lands nearby industrial estates. Gujarat is one of the most industrialized states in the country. The contribution of hazardous waste in Baroda, Ahmedabad, Valsad, Surat and Bharuch have been calculated to be about 38%, 22%, 17%, 12% and 11% respectively (Saxena and Vankatesan, 1995).

Metals in contaminated soils are present as chemical forms with different mobility and availability to human and ecological receptors. Consequently, there has been great concern for in-situ remedial strategies that render metals less mobile to minimize the environmental and human risks therefore it is advantageous to develop cost effective remediation strategies. FYM is the source of primary, secondary and micronutrient to the plant growth. It is a constant source of energy for heterotrophic microorganisms, help in increasing the availability of nutrient quality and quality of crop produce. Farm yard manure (FYM) improves the crop production (Kaihura *et al.*, 1999) as well as improves soil physical properties (Chen *et al.*, 1996) and can be used to reduce heavy metal hazards in plants (Yassen *et al.*, 2007). Organic matter with respective groups such as hydroxyl, phenolic and carboxyl effectively controls the adsorption and complexation of heavy metal and the activity of metal in the soil (Lee *et al.*, 2004; Mahmood, 2010).

### **Materials and Methods**

Incubation experiment was carried out to study the effect of cadmium (Cd) and farm yard manure (FYM) on DTPA- Cd at 0, 7, 14, 21, 28, 35 and 42 days after incubation to know DTPA extractable Cd of soil. At Department of Agricultural Chemistry and Soil Science, BACA, AAU, Anand with five levels of Cd (0, 10, 20, 40 and 80 mg kg<sup>-1</sup>) and two levels of FYM (0 and 1 %) on loamy sand

(*Typic Ustrochrepts*) soil. The experiment was laid out in a CRD (factorial) with three replications.

To study the effect of FYM and incubation days on release pattern of Cd and its availability in absence of plant, a laboratory incubation study was conducted. Different levels of Cd were incubated in soil to maintain moisture at 50% WHC to determine stabilization rate. Sample was taken from each 30 plastic cups at interval of 0, 7, 14, 21, 28, 35, 42 Days. These samples were analyzed for DTPA-Cd extraction. Sampling method was nondestructive.

### **Results and Discussion**

#### **Effect of incubation period**

The gradual decreasing trend was found in terms of incubation periods. As incubation periods increasing available Cd content was significantly decreasing in soil (Table 1). The lowest availability of Cd (23.78 mg kg<sup>-1</sup>) was noted at the end of the incubation periods (Day 42) and highest availability of Cd was noted at 0 day (27.56 mg kg<sup>-1</sup>). The percent of Cd decreasing was 13.71 per cent from Day 0 to Day 42 respectively.

#### **Effect of FYM**

Application of FYM significantly decreased the availability of Cd in the soil (Table 1). The decrease in the availability of Cd (5.04 per cent over control) was obtained under F<sub>1</sub> level (20 t ha<sup>-1</sup>) of FYM application. The lowest availability of Cd (24.85 ppm) was noted at the application of FYM @20 t ha<sup>-1</sup> and highest availability of Cd (26.17 ppm) was noted in no application of FYM.

Jones and Johnson (1989) documented that manure application affect the soil organic matter content, which may retain Cd in the

soil against leaching and crop uptake. Eriksson (1990) reported that increasing the sorption capacity of the soil by adding organic matter, as peat would tend to decrease the amount of available Cd in the soil solution. Sarkunan *et al.*, (1991) observed the decrease DTPA-extractable Cd in the soil due to addition of compost.

**Effect of cadmium**

With increasing rates of Cd application, there was a corresponding significant increase in the available Cd content of soil (Table 1). There was maximum available Cd content (69.37 mg kg<sup>-1</sup>) was found under 80 mg kg<sup>-1</sup> level and minimum available Cd content (0.04 mg kg<sup>-1</sup>) was found under 0 mg kg<sup>-1</sup> level. The findings

were agreement with (Sarkunan *et al.*, 1991).

**Interaction effect**

The D × F, D × Cd and F × Cd interactions for incubation study (Table 2, 3 and 4) were found to be significant.

**Effect of D X F interaction**

Combined effect of incubation days and FYM on the availability of Cd in the soil was given in the Table 2. Application of FYM @ 20 t ha<sup>-1</sup> reduced the availability of Cd in soil. With increasing incubation days there was decreasing available-Cd content was found significantly at all Cd levels except day-0 which was at par with day-7 in respect to available-Cd content.

**Table.1** DTPA-Cd (mg kg<sup>-1</sup>) as affected by levels of cadmium (Cd), FYM (F) and incubation period (D)

Treatments	Cd content (mg kg <sup>-1</sup> )	Treatments	Cd content (mg kg <sup>-1</sup> )
<b>Days after incubation (D)</b>		<b>Levels of FYM (F)</b>	
Day-0	27.56	F <sub>0</sub> : 0 % FYM	26.17
Day-7	26.81	F <sub>1</sub> : 1 % FYM	24.85
Day-14	26.39	<b>SEm ±</b>	<b>0.06</b>
Day-21	25.26	<b>CD (P=0.05)</b>	<b>0.17</b>
Day-28	24.75	<b>Levels of cadmium (Cd)</b>	
Day-35	24.04	Cd <sub>0</sub> : 0 mg kg <sup>-1</sup>	0.04
Day-42	23.78	Cd <sub>10</sub> : 10 mg kg <sup>-1</sup>	7.31
<b>SEm ±</b>	<b>0.11</b>	Cd <sub>20</sub> : 20 mg kg <sup>-1</sup>	16.40
<b>CD (P=0.05)</b>	<b>0.31</b>	Cd <sub>40</sub> : 40 mg kg <sup>-1</sup>	34.44
		Cd <sub>80</sub> : 80 mg kg <sup>-1</sup>	69.37
		<b>SEm ±</b>	<b>0.09</b>
		<b>CD (P=0.05)</b>	<b>0.26</b>
<b>Significant Interactions</b>		<b>D × F</b>	
		<b>D × Cd</b>	
		<b>F × Cd</b>	
<b>CV %</b>		<b>2.37</b>	

**Table.2** Interaction effect of days and FYM (D × F) on Cd(mg kg<sup>-1</sup>) status in soil

D X F	Day-0	Day-7	Day-14	Day-21	Day-28	Day-35	Day-42
F <sub>0</sub>	27.84	27.24	26.86	25.93	25.56	24.89	24.08
F <sub>1</sub>	27.28	26.38	25.92	24.58	23.94	23.18	22.67
SEm+ 0.16				CD (P=0.05) 0.44			

**Table.3** Interaction effect of days and cadmium (D × Cd) on Cd (mg kg<sup>-1</sup>) status in soil

D X Cd	Day-0	Day-7	Day-14	Day-21	Day-28	Day-35	Day-42
Cd <sub>0</sub>	0.03	0.02	0.03	0.03	0.03	0.02	0.02
Cd <sub>10</sub>	8.59	8.18	7.83	7.29	6.96	6.26	6.05
Cd <sub>20</sub>	18.38	17.81	17.43	16.38	15.62	14.72	14.49
Cd <sub>40</sub>	36.92	35.64	35.22	34.20	34.05	32.67	32.35
Cd <sub>80</sub>	73.88	72.34	71.44	68.39	67.08	66.51	65.96
SEm+ 0.25				CD (P=0.05) 0.70			

**Table.4** Interaction effect of FYM and cadmium (F × Cd) on Cd (mg kg<sup>-1</sup>) status in soil

F X Cd	F <sub>0</sub>	F <sub>1</sub>
Cd <sub>0</sub>	0.04	0.03
Cd <sub>10</sub>	7.58	7.03
Cd <sub>20</sub>	17.14	15.67
Cd <sub>40</sub>	35.40	33.59
Cd <sub>80</sub>	70.81	67.92
SEm+ 0.13		CD (P=0.05) 0.37

#### Effect of D X Cd interaction

Combined effect of incubation days and Cd on the availability of Cd in the soil was given in the Table 3. Data pertaining to available-Cd content in soil as influenced by D × Cd interaction showed that increasing trend in available- Cd content was found in soil with the increasing levels of Cd but with increasing incubation days, there was decreasing available-Cd content found significantly at all Cd levels.

The highest Available Cd found at 0 day and lowest available-Cd was found at day-42 in each Cd levels. Available-Cd<sub>0</sub>, Cd<sub>10</sub> and Cd<sub>20</sub> ppm was at par with day-7.

#### Effect of F X Cd interaction

Combined effect of Cd and FYM on the availability of Cd in the soil was given in the Table 4. Application of FYM @ 20 t ha<sup>-1</sup> reduced the availability of Cd in soil. This might be due to presence of carboxyl, hydroxyl and phenoxy group in FYM chelate the applied Cd in soil which ultimately decreased its availability.

In conclusion, the results of incubation study, the application of FYM and days of incubation reduced the DTPA-Cd content in soil, while with increase in Cd level increase the DTPA-Cd in incubation study.

The FYM application @ 20 t ha<sup>-1</sup> showed fixation of cadmium to the extent of 4.3 per cent under Cd<sub>80</sub> over no FYM application.

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