Madras Agric. J., 99 (7-9): 482-484, September 2012
https://doi.org/10.29321/MAJ.10.100119

Short Note

Influence of Cadmium on Paprika Chilli (*Capsicum annum*) and its Detoxification by Organic Amendments

A.K. Pal, A.K. Muduli*, B. Jena and R. Acharya
Micronutrient Laboratory,
Department of Soil Science & Agricultural Chemistry, OUAT, Bhubaneswar-751003, Odisha

A pot culture experiment was conducted in Dept of Soil Science & Agriculture Chemistry during 2010 to study the effect of farm yard manure (FYM) and poultry manure (PM) on detoxification of Cadmium in alfisol with *Capsicum annum* (cv. Kt-PI-19) as a test crop. The experiment was carried out with 24 treatment combinations (eight levels of Cd 0, 2.5, 5.0, 10.0, 20.0, 40.0, 80.0 and 160.0 mg kg^{-1} soil and three levels of organic manure; (control, FYM and PM @ 5 t ha^{-1}) with three replications in split plot design. With the application of organic matter, dry matter yield was increased at different levels of Cd application (5.97 to 17.2 g pot^{-1} in FYM and 5.34 to 17.63 g pot^{-1} in PM treatment, respectively). Cd content in shoot was 2.1 ppm in control and increased to 209.90 ppm at 160 ppm of Cd application. The Cd content was 2.6 and 4.3 ppm in FYM and PM treatment and increased to 133.60 and 111.4 ppm, respectively with the application of 160 ppm of Cd. The organic amendments by chelating organic complexes reduce the phytotoxicity activity which retards the availability of Cd from soil to plant. There was also detoxification of Cd content in post harvest soil samples.

Key words: Cadmium, Organic manure, Detoxification, Capsicum

Cadmium (Cd), a non essential element in plant nutrition, is readily taken up by roots and distributed throughout the plant. Accumulation of heavy metal resulted in phytotoxicity to plants or even transfer to food chain. The plant growth and biomass yield is affected at higher concentration (Chang, A.C *et. al.* 1982). Increasing use of industrial effluent and municipality sewage on agricultural land not only increased nutrient status and organic matter but also the heavy metal content of the soil. Continuous use of sewage, sludge and industrial effluents on agricultural land reported to increase the levels of trace metals (Rattan R.K. *et.al.* 2003). It needs attention to alleviate the metal content by using organic manure. Significant decrease in phytoavailability of metals was obtained upon addition of organic manure (Karapanagiotis *et al.* 1991) . On the contrary, increases in solubility of metal in soil amended with organic manure were reported by other workers (Narwal R.P. and Singh B.R. 1998, Shuman L.M. 1998). With these views, a pot culture experiment was laid out to study the effect of Cd on biomass yield of paparika chilly (*Capsicum annum* cv. Kt-PI-19) in alfisol, its accumulation on plant and to detoxify Cd content by using organic amendments.

Materials and Methods

A pot experiment was conducted during 2010 rabi with 24 treatment combinations; eight levels of Cd (i.e.) 0, 2.5, 5.0, 10.0, 20.0, 40.0, 80.0, 160.0 mg Kg^{-1} soil and three levels of organic manure (OM) (i.e.) Control, farm yard manure (FYM) @ 5 t ha^{-1} and poultry manure (PM) @ 5 t ha^{-1} with three replications in split plot design. Capsicum was grown in rabi season. The soil used for the study was sandy loam in texture, pH 5.6, EC 0.42 dS m^{-1} and organic carbon 0.42%. The soil was low in available N but medium in available K. The DTPA extractable Fe, Zn and Cd were 116, 0.43, and 0.033 mg Kg^{-1} respectively.

Ten kg of air dried soil was filled in earthen pots. The crop received N: P_2O_5: K_2O @ 120:60:120 kg ha^{-1} respectively. Full dose of P_2O_5 and half dose of K_2O and 20% of N were applied at planting and remaining N & K_2O were applied after 30 days of transplanting. FYM and PM @ 10 t ha^{-1} were well mixed with soil before transplanting. The pots were irrigated with deionized water from time to time. Then the seedlings of capsicum were transplanted. The plants were harvested at maximum vegetative stage and the plant shoot biomass was expressed on oven dry basis. The post harvest soils were analyzed for DTPA extractable cadmium. Plant shoots were washed with distilled water and then oven dried and digested with diacid mixture (HNO_3::$HClO_4$). The extract was determined with the help of Atomic Absorption Spectrophotometer.

Results and Discussion

Biomass yield of Capsicum

The oven dry matter yield of capsicum decreased with the increasing levels of Cd. The decrease was

*Corresponding author email: anilkumarmuduli@gmail.com

Table 1. Effect of graded doses of cadmium and organic amendments on shoot yield (g pot$_{-1}$) of Capsicum (on oven dry basis)

Levels of Cd (ppm)	Control	Farm Yard Manure(FYM @ 5 t ha$_{-1}$)	Poultry Manure (PM @ 5 t ha$_{-1}$)	Mean (g pot $^{-1}$)	% Decrease
0	16.08	17.20	17.63	16.97	-
2.5	15.75	16.61	16.53	16.30	03.90
5.0	11.23	15.17	15.19	13.86	18.30
10.0	10.88	13.50	13.30	12.56	25.90
20.0	09.68	10.74	10.35	10.26	39.50
40.0	08.91	09.47	09.20	09.19	45.80
80.0	08.47	09.20	09.10	08.92	47.40
160.0	06.28	05.97	05.34	05.86	65.40
Mean	10.91	12.23	12.08		
	Cd	OM	Cd X OM		
C.D	10.98	6.73	2.34		

Cd : Cadmium
OM : Organic manure

Table 2. Effect of organic amendments on cadmium content (ppm) in shoot of Capsicum.

Levels of Cd (ppm)	Control	Farm Yard Manure (FYM @ 5 t ha$_{-1}$)	Poultry Manure (PM @ 5 t ha$_{-1}$)	Mean (g pot $_{-1}$)
0	16.08	17.20	17.63	16.97
0	02.10	02.60	04.50	03.07
2.5	07.90	04.34	02.90	05.05
5.0	56.00	32.60	33.20	40.60
10.0	96.50	45.10	40.20	60.60
20.0	145.30	73.10	71.50	96.63
40.0	163.80	86.00	84.60	111.47
80.0	186.30	96.00	89.30	123.87
160.0	209.90	133.60	111.40	151.63
Mean	108.48	59.17	54.70	
	Cd	OM	Cd X OM	
C.D	157.63	96.53	63.31	

Cd : Cadmium
OM : Organic manure

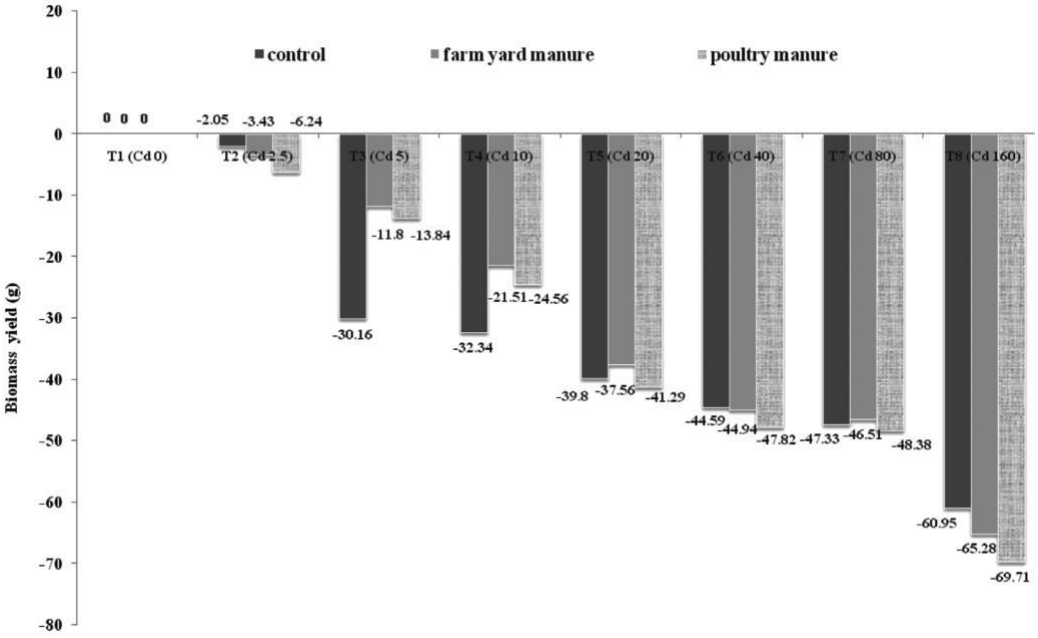

Fig. 1. Effect of organic amendments (Farm Yard Manure and Poultry Manure) on biomass yield of Capsicum

from 16.97 to 5.86 g pot $_{-1}$. The higher level of Cd @ 160 mg kg$_{-1}$ resulted in 65% decrease in dry matter content. With the application of organic matter and Cd, yield was increased over control at different

Table 3. Cadmium concentration (ppm) in post harvest (after 60 days) soil.

Levels of Cd (ppm)	Control	Farm Yard Manure (FYM @ 5 t ha$_{-1}$)	Poultry Manure (PM @ 5 t ha$_{-1}$)	Mean (g pot $_{-1}$)
0	00.44	00.50	00.96	00.63
2.5	01.18	01.66	01.66	01.50
5.0	02.60	01.96	01.70	02.09
10.0	07.34	03.74	03.04	04.71
20.0	13.20	12.30	12.36	12.62
40.0	36.14	26.33	23.28	28.58
80.0	46.50	37.60	26.12	36.74
160.0	59.00	47.92	36.60	47.84
Mean	20.80	16.50	13.22	
	Cd	OM	Cd X OM	
CD	52.38	32.08	04.86	

Cd : Cadmium
OM : Organic manure

levels of Cd (Table 1). The values ranged from 5.97 to 17.2 g pot $_{-1}$ and 5.30 to 17.63 g pot $_{-1}$ in FYM and PM treatment, respectively (Fig 1).

Table 4. Per cent increase/decrease in Cadmium concentration of post harvest soil over control

Levels of Cd (ppm)	Farm Yard Manure (FYM @ 5 t ha$_{-1}$)	Poultry Manure (PM @ 5 t ha$_{-1}$)
0	13.6	118.2
2.5	40.7	40.7
5.0	-24.6	-34.6
10.0	-49.0	-58.6
20.0	-6.8	-6.4
40.0	-27.1	-35.6
80.0	-19.1	-43.8
160.0	-18.8	-38.0

Cadmium content in Shoot

Cadmium accumulation in plants increased significantly with addition of Cd application (Table 2).

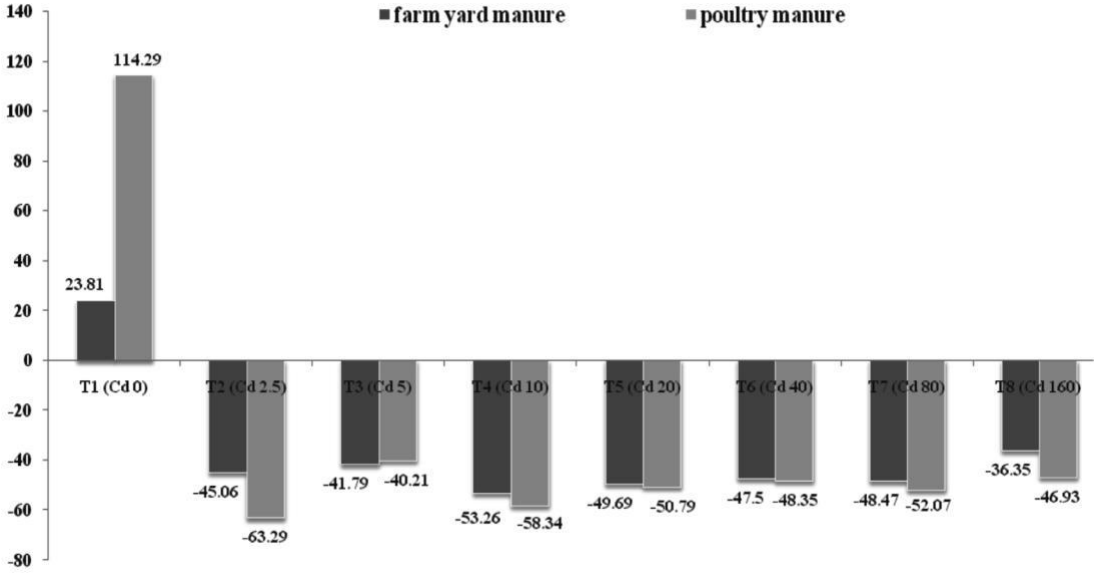

Fig. 2. Effect of organic amendments (Farm Yard Manure and Poultry Manure) on per cent detoxification of Cd in Capsicum

Cd content in capsicum shoot was 2.1 ppm at control (Cd_0OM_0) and increased to 209.90 ppm at 160 ppm of Cd. On the other hand, Cd content in FYM and PM treatment (with Cd_0) was 2.6 and 4.5 ppm, respectively. The increase was from 2.6 to 133.60 ppm in FYM treatment and 4.5 to 111.4 ppm in PM treatment, respectively, at 160 ppm of Cd. The organic amendments reduced the phytotoxic acitivity by chelating Cd with the organic manure (Fig 2). Shoot accumulates a major quantity of Cd than fruit (Quadir.M *et. al.* 2006).

Soil

Cadmium content in post harvest soil is presented in Table 3. The results showed that the application of Cd at higher level, the Cd content of soil increased and it ranged from 0.44 to 59.00 mg ha^{-1} in control where as it increased from 0.5 to 47.92 and 0.96 to 36.6 mg kg^{-1} in FYM and PM treated pots, respectively. The results showed that Cd concentration in soil decreased to 38.2% due to addition of organic amendments up to 2.5 ppm of Cd. Thereafter increased in higher doses may be due to chelating effect of organic manures (Table 4).

Conclusion

The study revealed that the addition of Cd decreased the dry matter yield of plant but addition of organic amendment enhanced the dry matter yield. Cadmium was detoxified in the post harvest soil. It was further detoxified by addition of organic amendments in the form of chelates which ultimately retard the availability of Cd from soil to plants as evidenced from enhanced yield.

References

Chang, A.C., Page, A.C., Foster, K.W. and Jones, T.E. 1982. A comparison of cadmium and zinc accumulation by four cultivars of barley grown in sludge-amended soil. *J.Environ. Qual.,* **II**, 409-412.

Karapanagiotis, N.K., Sterritt, R.N. and Lester, J.N. 1991. Heavy metal complication in sludge amended soil. Role of organic matter in metal retention. *Environ. Technol.,* **12**, 1107-1116.

Narwal, R.P. and Singh, B.R. 1998. Effect of organic materials on portioning, extracting on plant uptake of metal in a alum shale soil. *Water, Air and Soil Pollution* **103**, 405-421.

Shuman, L.M. 1998. Effect of organic waster amendment on Cd and Pb in soil fraction of two soils. *Comm. Soil Sci. Plant Analysis,* **29**: 2939-2952.

Rattan, R.K.,Datta, S.P., Chandra, S. and Saharan, N. 2002. Heavy metals and environmental quality: Indian scenario. *Fertil. News*. **47**: 21-40.

Quadir, M., Ghafoor, A. and Murtaza. 2006. Cd concentration in vegetables grown in urban soils irrigated with untreated municipal sewage. Dept. soil science, Univ. of Agriculture, Faisalabad 38040, Pakistan.

Received: November 8, 2011; Accepted: May 23, 2012