RESEARCH ARTICLE

Changes in Chlorophyll Contents in Plants Grown in Municipal Solid Waste

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ABSTRACT

A study investigated during the remediation effect of nutrient amendments of municipal solid waste polluted soil on chlorophyll contents of *T. stans*, *C. tora*, *P. pinnata*, *B. napus*, *A. manihot, T. erecta* ,*C. officinalis* and B. *juncea*. Soil samples were polluted with different waste material viz. 30-45 % organic matter, 6-10 % recyclables and the rest as inert matter. Municipal solid waste soil samples from Sukali compost, landfill depot sites, Amravati were collected and selected plants were grown for further study. The data indicates that Municipal solid waste contaminated soil may have improved chlorophyll contents of some plants. The chlorophyll contents significantly increase in some plants i.e. *C. tora*, *P. pinnata*, *T. erecta*, *B. napus* and *A. manihot* and affected adversely on remaining plants i.e. *T. stans*, *P. pinnata* and *B. juncea*.

Key words: Municipal solid waste, remediation, heavy metals, waste soil, control soil and chlorophyll.

INTRODUCTION

In Indian cities, solid waste generation rate is continuously goes on increasing day by day in most of states, metropolitan and large cities. The average per capita solid waste generation in India (EPTRI, 1995) has increased from 0.32 kg/day in 1971-73 to 0.48 kg/day in 1994. In 1995, EPRIT, Hyderabad showed that 23 big Indian cities generated 11 million tons (million tons) of solid waste every year. The Solid Waste Management in state of Maharashtra, particularly in its major cities, is of serious concern. Sukali compost and landfill depot, Amravati selected for study, this landfill site is a highly disturbed area, because of the constant turning of soil due to solid waste dumping. About 79 % of land in Sukali compost depot are totally filled up only remain 21 % of land for further loading of waste material, it also filled up in upcoming year. Hence, it is necessary study critically on present situation and to suggest possible solutions for its safe management for disposal. The aim of present study was to analyze various minerals, nutrients and heavy metals of waste soil. After analysis of various different parameters of waste soil, second part of the investigation was carried out to study its effect on chlorophyll content of some plants.

MATERIALS AND METHODS

Selection of site and sample collection: Soil samples were collected in summer season 2009-2011 from 3 different spots of Sukali compost depot.

Physicochemical and Metal analysis: Moisture content (Dhyansingh et al.,

1999) and soil texture (Arora and Pathak, 1989) was analyze. pH, Electrical conductivity and temperature of the soil was measured by pH meter, conductivity meter and thermometer. Colour notations indicated by using Munsell`s soil colour chart. Na, K and Ca ions was analyzed by flame photometer (Hanway and Heidel, 1952). The organic carbon in the sample was oxidized with potassium dichromate and sulphuric acid (Walkely and Black, 1934). Calcium carbonate by titrimetric method (Piper, 1966). The chloride content of the soil was directly measured by titrimetric method (Santra et al., 2006). Detection and analysis of metal ions such as Cu, Zn, Cr, Ni, Fe, Mn and Co from soil and sediments, wet oxidation of sample were carried out. Wet oxidation employs oxidizing acids like HNO_3 – $HCLO_4$ di- acid mixture (Jackson, 1958).

Chlorophyll contents of plants: Chlorophyll was extracted in 80% acetone and absorbance at 663 nm and 645 nm on using UV-Visible spectrophotometer (Elico SL 164). Leaves samples with control and treatments were estimated following the procedure of (Whatley and Arnon, 1963).

Statistical analysis: The difference between control and waste soil compared using *t* tests and significant differences were found at ($p< 0.01$), ($p< 0.05$) and ($p< 0.2$).

RESULTS AND DISCUSSION

A rise in temperature of soil accelerates chemical reactions, reduces solubility of gases and decrease pH of soil. The soils are neutral to alkaline in reaction; pH of control soil was (7.76) slightly lower as compared to waste soil (8.37).The organic carbon content in waste soil (43.17 %) its higher than in control soil (34.35 %). Moisture content in waste soil was found to be very low (3.92 %) as compared to control soil (6.62 %). The chlorides content in waste soil (49.7 mg/ kg) it was 20-30 % higher than control soil (42.6 mg/ kg). The conductivity of waste soil was much higher (1.792 $X10^6$) than control (0.128 $X10^6$). The overall mean exchangeable bases in waste soils were record as to be Na (26.5 mg/kg), K (89 mg/kg), Ca (400 mg/kg), $CaCo_3$ (79.1 %) respectively. In waste soil Na, K and $CaCo_3$ concentration 50-70 % higher than garden soil (control). The distribution of metals concentration present in the soil is shown in **(Table)**. Iron (Fe) was the highest concentration in both the waste and garden (control) soil. Zinc (Zn) and Manganese (Mn) second highest element in waste soil its concentration somewhat higher than garden (control) soil. Cobalt was totally absent in control as well as waste soil. Cr concentration in waste soil was 30-35 % higher than control soil. Cu concentration in waste soil was recorded 65-70 % higher than control.

Table 1: Physicochemical analyses of waste soil collect from Municipal Corporation Sukali compost and landfill Depot, Amravati.

Sr.No.	Parameters	Garden (Control Soil)	Municipal (Waste Soil)
1	Temperature(^{0}C)	32.4	35.5
2	pH	7.76	8.37
3	Colour	Dark reddish brown	Grayish dark brown
4	Moiture content (%)	6.62	3.93
5	Moisture correction factor (mcf)	1.06	0.13
6	Soil texture	Sandy loam	Sandy
7	Organic Carban (%)	34.35	43.17
8	Chlorides (mg/Kg)	42.6	49.7
9	Conductivity µmoho/m	0.128 $X10^6$	1.792$X10^6$
10	Na (mg/Kg)	4	26.5
11	K (mg/Kg)	13	89
12	Ca (mg/Kg)	890	400
13	$CaCO_3$ (%)	24.16	79.1
14	Heavy Metals		
I	Cu (mg/g)	0.699	1.001
II	Zn (mg/g)	1.684	5.058
III	Cr (mg/g)	0.168	0.536
IV	Ni (mg/g)	0.061	0.053
V	Fe (mg/g)	22.41	21.65
VI	Mn (mg/g)	4.695	5.982
VII	Co (mg/g)	-0.075	-0.100

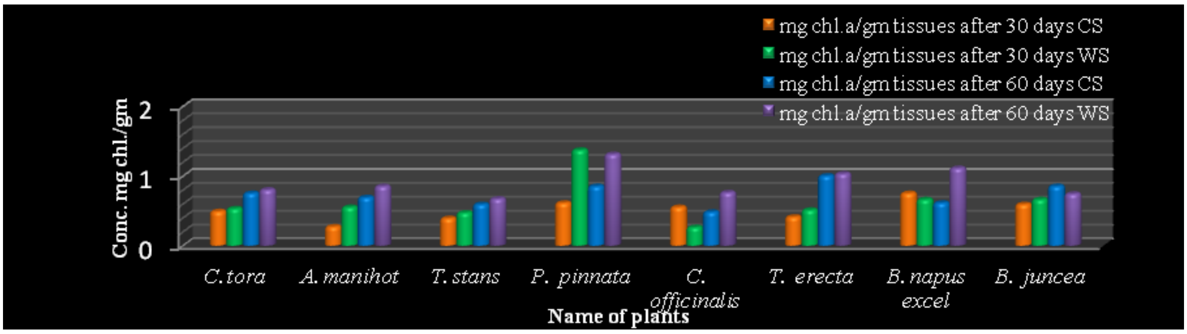

Fig. 1: Comparative study of Chl. a content in various plant species grown in CS and WS.

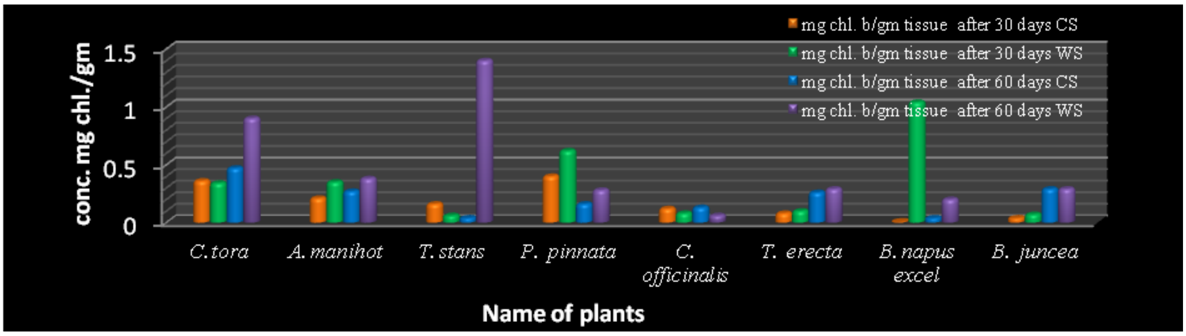

Fig. 2: Comparative study of Chl. b content in various plant species grown in CS and WS.

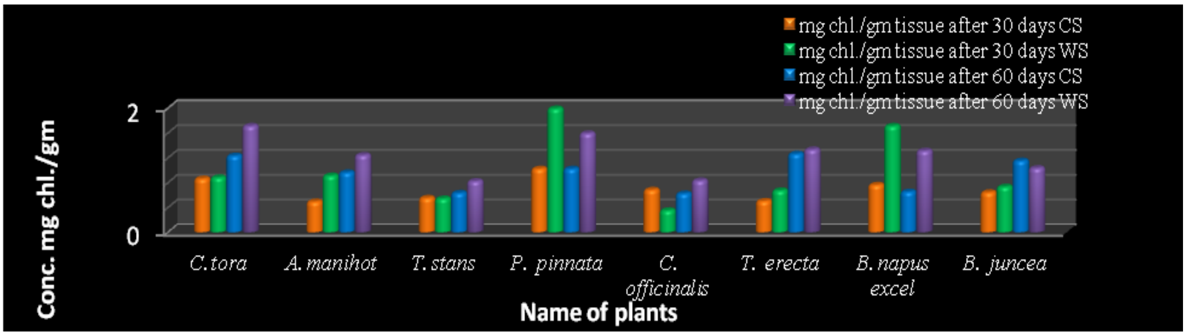

Fig. 3: Comparative study of total Chl. content in various plant species grown in CS and WS.

Effect of municipal solid waste on chlorophyll contents plants

The comparative study of chlorophyll content (Chl. a, Chl. b and total Chl.) in the number of plants grown in WS and CS after 30 and 60 days were shown in Fig 1 to 3. The data recorded from the present study, some of the plants were grow in waste soil i.e. *P. pinnata*, *T. erecta* and *B. napus excel* recorded highest concentration of chl. a during experimental period (Fig.1). However relation between chl. a after 30 and 60 days in CS and WS growing plants, higher amount of chl. a were recorded in WS growing plants as compared to CS except *B. juncea.* Analysis of variance showed that the effect of WS treatment was statistically significant at $p < 0.2$ percent level after 30 days and $p < 0.05$ percent level after 60 days (Fig. 1).

The plants were growing in waste soil i.e. *T. stans* and *C. tora* recorded highest conc. of chl. b during experimental period (Fig. 2). However relation between chl. b after 30 and 60 days in CS and WS growing plants, higher amount of chl. b was recorded in WS growing plants as compared to CS. Higher amount of chl. b contents were found in *T. stans*, *C. tora*, *P. pinnata* and *B. napus* (70-85 %); *A. manihot* and *T. erecta* (40-60 %).*C. officinalis* and B. *juncea* chl. b contents was higher or equal in CS as compared to WS. Analysis of variance showed that the effect of WS treatment was statistically significant in $p < 0.2$ percent level after 30 days and $p < 0.05$ percent level after 60 days in some plants i.e. *T. stans*, *C. tora*, *P. pinnata*, *B. napus*, *A. manihot* and *T. erecta* (Fig.2). The maximum amount of total Chl. contents recorded in WS in some plants i.e. *C. tora*, *P. pinnata*, *T. erecta*, *B. napus* and *A. manihot*

(Fig. 3). Relation in total chlorophyll amounts (Fig. 3) in WS and CS, in *C. tora* (35-40 %), *A. manihot* (20-22 %), *T. stans* (20-21 %), *C. officinalis* (30-32 %), *T. erecta* (35-37 %) and *B. juncea* (25-27 %) higher in WS as compared to CS growing plants after 30 and 60 days. Analysis of variance showed that the effect of WS treatment on total chl. production of plants was statistically significant in $p < 0.2$ and $p < 0.05$ percent level after 30 days and $p < 0.05$ and $p < 0.01$ percent level after 60 days in some plants.

Anikwe and Nwobodo (2001) reported that municipal wastes increase the nitrogen, pH, cation exchange capacity (K, Na, Cl etc.), percentage of base saturation and organic matter. In present study, the concentration of K in WS was 80-90 % higher over the CS (Table). Potassium has reported to be involved in maximum increase in nutrient uptake by virtue of more photosynthesis resulting in more chlorophyll formation with an increased leaf area (Belorkar et al., 1992). All these plants tolerate higher concentration of heavy metal. The result of present study shows that, the plants absorbs and extracts more amount of Cu from waste soil, it affect on total chlorophyll content of plant. Chlorophyll pigment play an important role in photosynthesis, its sensitivity hampers the biomass production. Hall and Williams (2003) reported that Cu is an integral component of certain electron transfer proteins in photosynthesis (e.g. plastocyanin) and respiration (e.g. Cytochrome C oxidase) and it plays a significant role in growth and chlorophyll production. In *P. pinnata* (32-33 %) and *B. napus* (5-6 %) rise total chl. contents after 30 days this value lowered down after 60 days in *P. pinnata* (15-16 %) due to metal saturation increased after 60 days (Shirbhate and Malode, 2012).

CONCLUSION

All the recorded minerals and metals in waste soil samples were 30-80 folds higher than garden soil (control soil - CS). Minerals and metals of waste soil (WS) sometimes involve in growth of some plants. The different elements of waste soil involved in maximum increase in nutrient uptake by virtue of more photosynthesis resulting in more chlorophyll formation. In this way it may possible to solve environmental pollution problems also.

REFERENCES

Anikwe MAN, Nwobodo KCA (2001) Long Term Effect of Municipal Waste Disposal on Soil Properties and productivity of Sites used for Urban Agriculture in Abakaliki, Nigeria. Bioresources Technol., 83, 241-251.

Arora S, Pathak, SC(1989)Laboratory techniques in modern biology. 2ndEdi.KalyaniPublishers,New Delhi-110002, 73-89.

Belorkar PV, Patel BN, Golliwar VJ, Kothare AJ (1992) Effect of Nitrogen and spacing on growth, flowering and yield of African marigold. Journal of soils crops, 2:15-27; 62-64.

Dhyan Singh, ChhonkarP K, Pandey R N (1999) Soil plant and water analysis –A method manual. IARI, New Delhi,pp 255.

Environment Protection Training and Research Institute (EPTRI) (1995)Hyderabad, Status of Solid Waste Disposal in Metropolis Hyderabad, 46.

Hall JL, Williams LE (2003) Transition metals transporters in plants. Journal of Experimental Botany, 54(393):2601-2613.

Hanway JJ, Heidel H (1952) Soil analysis methods as used in lowa state college soil testing laboratory,Lowa Agri.57.1-31. http://www.cpcb.com

Jackson ML (1958) Soil and Chemical Analysis. Prentic-Hall, Englewood Cliffs, NJ, USA.

Kim KH, Kim SH (1999). Water, Air and Soil Pollution, 111:109-122.

Klorke A (1979) Content of arsenic, cadmium, chromium, fluoride, lead, mercury and nickel in plants grown on contaminated soil, paper presented at united Nations-ECE Symposium. In Chon HT, Ahn, JS, Jung, MC, 672-679.

Piper CS (1966) Soil and plant analysis. Hans's publications, Bombay.

Santra SC, Chatterji TP, Das AP (2006) College Botany Practical.Vol.1New Central Book Agency (P) Ltd.221.

Shirbhate N,Malode S. N.(2012) Heavy metals phytoremediation by *Pongamiapinnata* (L) growing in contaminated soil from municipal solid waste landfills and compost Sukali depot, Amravati (M.S.). International Journal of advanced biological research, Vol.2 (1):147-152.

Walkely AJ,Black IA (1934) Estimation soil organic carbon by chromic acid titration method. Soil sci., 37, 29-38.

Whatley FR, Arnon DI (1963)Methods in Enzymology, Academic Press, New York, 1: 308.