HEAVY METALS IMPACT ON BRACHIARIA MUTICA, A FODDER GRASS DURING SEWAGE WATER IRRIGATION

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Key words: Heavy metal, Brachiaria mutica, Fodder grass, Sewage irrigation

ABSTRACT

Effect of urban sewage water irrigation on the concentration of heavy metals in paragrass was studied. Heavy metals viz., copper, lead, zinc, nickel, chromium were estimated for their concentration in sewage water irrigated and also with regular irrigation. These experiments were conducted in summer and rainy seasons with dryland, irrigated and water logged grown plants. The concentration of heavy metals were considerably high with sewage water irrigated plants. Among the types of sewage water irrigations studied, dryland condition recorded the least concentration of copper, when compared to water logged conditions and furrow irrigated plants. On the contrary the other heavy metal lead recorded only in the dryland condition. However, any of the heavy metals were not recorded with the control plants. The role of urban sewage water irrigation in contributing to the heavy metals for plants was discussed in the present paper.

INTRODUCTION

Brachiaria mutica (paragrass) is one of the few tropical pasture grasses, which is cultivated in large scale farming. It is a nutritious, high yielding and palatable forage grass which has in recent years gained considerable economic importance. The widespread use of B. mutica may be explained by the ease with which it could be vegetatively propagated, its competitive vigorous, high yield and good quality of herbage. It has adapted to the rice growing areas
of the world. However, the genus as a whole and *B. mutica* in particular have not been studied with regard to the environmental (sewage) pollution, their biology and fodder value.

The problems of water pollution due to sewage wastes have attained greater dimensions in India. The wastewater contains nutrients which enhance the growth of the crop plants. Industrial wastewaters are being used for irrigation in some areas due to water scarcity. Many municipalities in India provide little or no treatment of their sewage before discharging it (Bouwer, 1968). The discharge of domestic wastewater into fresh water bodies has enriched them with nutrients with consequent deterioration of water quality accompanied by eutrophication.

Almost all metals are toxic at high concentrations and some are lethal even in low concentration. Sewage sludge contains higher concentration of heavy metals (Vanloon and Lichwa, 1973; Larson *et al.* 1975; Davis and Jeknow, 1975; Arora and Azad, 1985). Different heavy metals have been shown to inhibit various metabolic processes in plants resulting in their reduced growth and development (Davies, 1991). Sewage is used for irrigating agricultural fields (Sauerbeck, 1987) which increase crop production and result in accumulation of heavy metals (Sommers *et al.* 1976). The contamination of soil with heavy metals from sewage will result in phytotoxicity (Chaney *et al.* 1978) and increased movement of metals into the food chain. However, it is important to see that the root growth may be much affected by the heavy metals present in coal dump (Kumar *et al.* 2003) and in that area suitable soil amendments are required to minimize the effect of heavy metals. Soil amendment is one of the best to support plant growth and establishment on the coal dumps (Kumar, 2002) and according to (Singh *et al.* 2002) mining can give rise to high concentration of heavy metals like Al, Mn, Fe, Zn, Pb, Cu, Cr, Cd, and Ni. So in the present study level and concentration of heavy metals in sewage water irrigated *B. mutica* plants were estimated.

**MATERIALS AND METHODS**

The present investigation has been carried out to evaluate the physico-chemical properties of the sewage water, sewage irrigated soils, where *B. mutica* grows. The research experiments comprise of both field and laboratory studies. These experiments have been carried out in the sewage water irrigated research sites, where the effluent flows outside the city. Dryland, Irrigated and waterlogged conditions have been maintained in the present studies. All experiments were conducted both during rainy and summer seasons.

Some experiments have been designed to evaluate physico-chemical properties of sewage waters and the sewage irrigated polluted soils. Laboratory experiments were conducted to study effects of sewage irrigation on heavy metal composition features of *B. mutica*.

**Sample preparation**

Crushed leaves of *B. mutica* were placed in a silica crucible with electric heat-

ing mantle at 500°C and were dried to obtain ash. One g of ash was mixed with 10mL of concentrated HNO₃ and 5 mL of 90% HCl. The samples were digested on hot plate, again 10 mL of HCl were added and to make up 100 mL with distilled water. Thus 1000 ppm sample was prepared (De, 1992). From this sample heavy metals were analysed.

**Estimation of copper**

To 50 mL of the above prepared sample, 2 mL of ammonia, 5 mL of 20% ammonium citrate and 1 mL of dithiocarbonate were added in to a flask: It turned yellow at 440 nm with a calorimeter the optical density (OD) was noted (De, 1992).

**Estimation of lead**

50 mL of the prepared sample was poured to a flask, 10 mL of 5% Km NO₃ solution and 3 mL concentration sulphuric acid were added, then refluxed for four hours and cooled. Forty per cent NH₄ OH was added to reduce KMNO₄, filtered and made upto 100 mL. To this sample 30 mL ammoniacal sulphite cyanide solution and 10 mL dithizone solution were added. The solution was shaken vigorously for 30 seconds. Absorbance of the red extract was noted at 515 nm against reagent blank (De, 1992). Apart from copper and lead, the samples were also analysed for heavy metals like zinc, nickel, chromium by standard procedure of De (1992).

**RESULTS**

Heavy metal pollutants like zinc, nickel, chromium, copper and lead are toxic as they are known to influence the biological systems at various levels. Various heavy metal ions are released into the environment, these metals present in the atmosphere and soil, may enter plants either by their root system or by foliar uptake, further inhibiting photosynthesis and transpiration.

In the present study, heavy metals are estimated from the leaf samples and following are the results:

Plants grown in sewage irrigated water accumulate heavy metals in their tissues. Heavy metals in *B. mutica* leaves were recorded. The source of copper present in all sewage irrigated plants which comes from the sewage due to the activities of small electrical parts manufacturing units, metal cleaning and from jewellery shops. Another heavy metal, lead was also recorded, from the waste waters of printing press, vehicles wash and also from the smoke emitted by vehicles. Leaves show the presence of lead in plants growing closer to the main road.

**Copper**

Copper content was more in plants during summer season than that of rainy season. Copper content fluctuated from a minimum of 0.04 mg/g tissue in dry land conditions to a maximum of 1.40 mg/g tissue in waterlogged conditions. A difference in copper content was noted between summer and rainy seasons. However, in control plants, copper was not detected (Table 1).
Lead
Generally there was much difference in the lead recorded during summer season from that of rainy season. The maximum lead 1.46 mg/g tissue was recorded in dry land conditions during summer season and a minimum of 0.0 mg/g tissue in waterlogged conditions. In control plants, lead was not detected (Table 1). In plant tissue the other heavy metals like zinc, nickel, chromium were absent.

DISCUSSION
Accumulation of heavy metals in plant parts irrigated by polluted water is known to be hazardous (Venkatesan et al. 1996). Therefore, the practice of irrigation with heavy metal polluted water leads to a deceptive pollution problem encouraged by better growth and yield of plants in such polluted soils. The practice of irrigating with polluted water, has unknowingly created the heavy metal toxicity.

The study of accumulation of heavy metal in B. mutica is important from the point of view of its potential toxicity to livestock. So it may be inferred that proper attention should be given for controlling the discharge of heavy metals. Although repeated applications of the municipal water did not result in proportionally higher concentration of heavy metals in plants, the potential for toxicity cannot be excluded. In B. mutica, heavy metals accumulation in the tissue may have varied toxicity ranges. The biomass decreased considerably in waterlogged conditions as the toxicity increased. Thus, there is a clear correlation between the heavy metal toxicity and the plant growth. Similar observations were reported by Davies (1991).

Lead is one of the few metals that has been reported to have toxic effects, but it is known to have no essential function in the organisms. The biggest source of lead in atmosphere is automobile exhaust. Investigations on environmental lead concentration have been undertaken in recent years. During this period, automobile pollution has been much greater than that of any other single source of lead in atmosphere (Venkatesan et al. 1996). Investigations on environmental lead concentration have been undertaken in recent years. During this period, automobile pollution has been much greater than that of any other single source of lead in atmosphere.

Table 1
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<th>Table 1</th>
<th>Heavy metal composition in sewage irrigated B.mutica</th>
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<tr>
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<td>Sewage Irrigated Plants</td>
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<td>Dry land condition</td>
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<td>1. Copper (mg/g tissue)</td>
<td>0.04 ± 0.04</td>
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<tr>
<td>2. Lead (mg/g tissue)</td>
<td>0.03 ± 0.09</td>
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<tr>
<td>3. Zinc (mg/g tissue)</td>
<td>1.46 ± 0.18</td>
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<td>4. Nickel (mg/g tissue)</td>
<td>0.81 ± 0.02</td>
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Values are the means ± S.E of four replicates each and two consecutive seasons. Data were subjected to analysis of variance & compared for significance according to DMRT (P = 0.05) and lead are less mobile metals, and their contents increased to sewage sludge adhesion. The present study reveals the presence of copper in Mysore city sewage water. Maximum amount of copper was recorded at waterlogged conditions and maximum lead was recorded in dryland conditions during summer seasons. It is essential to reduce the heavy metal content of sewage sludge application to land. Aquatic plants can be safely used for retention of heavy metals (Trivedy, 2000). Sewage plants sometimes concentrate heavy metals to a fairly high level even from domestic wastewater, which is generally expected to be low in metal concentration. The above observation shows that preventive measures should be taken to remove heavy metal prior to the application of sewage water to agricultural lands.

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