Effects of industrial solid waste on Total net primary productivity of different Harvesting days on Solanum melongena L. (Brinjal)

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Abstract: The Industrial solid waste samples were collected at the outlet of release channel of the “Oil and Gas Industry” at Kakinada, air-dried and was brought to the laboratory. The soil amendments were prepared for as Control, Amendment 1,2,3 and 4. The NPP values for C plants increased from 21-51 day period to 51-81 day period and thereafter declined. The same trend was evident in the plants from A1, A2, A3 and A4 soils. However, when compared with that of the C plants, the TNPP reduced significantly in A1, A2, A3 and A4 soils during 21-51 days and the decrease has ranged from 42% in A2 soil to 77% in A4 soils. The Copper, Zinc, Iron and Manganese heavy metals were accumulated in the industrial solid waste. The results of this study stress the need for environmental awareness, adequate regulations and proper management of waste sites by the local municipal authorities and Pollution control board take the necessary actions to control Industrial solid waste disposal site on the Kakinada, Andhra Pradesh and India.

Key words: Disposal, Harvesting Days, Industrial solid waste, Solanum melongena L., Total net primary productivity.

I. Introduction

Nowadays industrial solid waste management is an important part of industry. The number of contaminated sites, which are polluted by industrial and hazardous waste, are increasing in developing countries (Freeman., 1989; Woodard., 2001; Lagrega et al., 2001). Heavy metals can accumulate in living organisms in living organisms and cause various diseases (Massodalam., 2001). Heavy metal toxicity is potentially dangerous because of bioaccumulation though the food chain and this can cause hazards effects on livestock and human health (Aycicek., 2008; Aschner., 2002).

The contamination of Industrial solid wastes including mine wastes has become a worldwide concern. Several authors have shown a relationship between atmospheric elemental deposition and elevated elemental concentrations in plants and top soils, especially in cities and in the vicinity of emitting factories (Andersen et al., 1978; Pilegaard., 1978; Harrison & Chirgawi., 1989; Larsen et al., 1992; Sanchez-Camazano et al., 1994). Over the last 15 years there has been an increasing interest in developing a plant based technology (phyto-remediation) to remediate heavy metal contaminated soils (Cunningham and Berti., 1993; Raskin et al., 1994). Plants growing on polluted soils, may accumulate trace elements at concentrations higher than the normal, may pose serious health risks to humans and livestock when these are consumed (Hoymand et al., 1983; Huchabee et al., 1983; Kabata-Pendias and Pendias., 1984; Alloway., 1990).

A significant buildup of the toxic metals in different organs or tissues of the organisms result through biological magnification (Sahu., 1987 and Choudhury., 1992). Heavy metals such as manganese (Mn), copper (Cu), iron (Fe), zinc (Zn) and nickel (Ni) are essential mineral nutrients for higher plants. Cu also induces toxicity in tissue concentrations slightly above its optimal levels (Fernandes & Henriques., 1991). The exposure of plants to toxic levels of heavy metals triggers a wide range of physiological and metabolic alterations (Dubey., 2011; Villiers et al., 2011). The most widespread visual evidence of heavy metal toxicity is a reduction in plant growth (Sharma et al., 1978; Pilegaard., 1978; Harrison & Chirgawi., 1989; Larsen et al., 1992; Sanchez-Camazano et al., 1994).

II. Study Area

The Kakinada city is the capital of East Godavari District of Andhra Pradesh on the central east coast of India. The area under study Kakinada is located at 16°56′N 82°13′E. It has an average elevation of 2 metres (6 ft) and many areas of the city are below sea level. The present study deals with the Heavy Metal Contamination of Groundwater Due to Industrial Solid Waste Disposal in Kakinada, Andhra Pradesh, India.
III. Material and Methods

LABORATORY EXPERIMENTS

A. Industrial Sludge Waste Collection

The Industrial solid waste samples were collected at the outlet of release channel of the “Oil and Gas Industry” at Kakinada; air-dried and was brought to the laboratory. Site longitude, latitude and altitude values are 82°16’24.42”E; 17°1’24.60”N and 5 m. The dried material was powdered in a mortar. ISW Disposal area longitude and latitude values are 17°01’27.52”N and 82°16’28.48”E.

B. SEED MATERIAL COLLECTION

The seeds of (Brinjal) Solanum melongena L. variety: were procured from an Agricultural Cooperative Centre at Kakinada, East Godavari district, Andhra Pradesh.

C. COLLECTION OF THE SOIL SAMPLING

Soil from the conventional crop fields near the (ISW) Oil and Gas factory (East Godavari District, Andhra Pradesh, Kakinada) was selected and used in the experimental studies on Solanum melongena L.. Soil samples were collected randomly from the field in five replicates and air dried for 72 hours, powdered, sieved through 2 mm sieve and subjected to physico-chemical analysis. The Soil from the Conventional Crop Field longitude and latitude values are 17°01’24.55”N and 82°16’29.05”E.

Table 1: PREPARATION OF THE SOIL AMENDMENTS

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Amendements Composition</th>
<th>Amendements Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100% Control Soil</td>
<td>Control (C)</td>
</tr>
<tr>
<td>2</td>
<td>95 % Control Soil + 5 % ISW</td>
<td>Amendment 1 (A1soil)</td>
</tr>
<tr>
<td>3</td>
<td>90 % Control Soil + 10 % ISW</td>
<td>Amendment 2 (A2soil)</td>
</tr>
<tr>
<td>4</td>
<td>70 % Control Soil + 30 % ISW</td>
<td>Amendment 3 (A3soil)</td>
</tr>
<tr>
<td>5</td>
<td>50 % Control Soil + 50 % ISW</td>
<td>Amendment 4 (A4soil)</td>
</tr>
</tbody>
</table>

D. POT EXPERIMENTS

The POT Experiment was conducted with the Amendments like Control, A1, A2, A3 and A4 Soils. Although pot experiments on the growth and yield of Brinjal (Solanum melongena L.) were conducted with the amended soils, the germination performance of the seeds of Solanum melongena L. was tested following the method described by Carley and Watson (1968) [20] with the water extract of the Solid waste. This is mainly because of the fact that the germination process is relatively rapid process in petridishes culture when compared to soil. The water extract of the solid waste extract was thoroughly hand shaken before experimental use. Graded concentrations of the water extract of the solid waste were prepared using the distilled water as diluent. For each experiment, 25 seeds of Solanum were taken in sterilized petridishes (15×20 cms) at equal distance. These were treated with equal doses of different concentrations (V/V) of water extract of the solid waste (5%, 10%, 30%, 50%) as and when necessary. Seeds treated with distilled water were maintained as control. Four replicates were maintained for each treatment including the control. The petridishes were kept under diffused light at room temperature (28 ± 1°C). Emergence of radical having atleast 5mm length was taken as indicative of germination. Percentage germination
was recorded as per the method specified by Carley and Watson (1968) [20]. One-week-old seedlings in experimental pots were used for measurement of seedling growth (root and shoot). The dry mass of shoot and root was recorded from 7 day-old seedlings after keeping them in an oven at 80°C for 72 hr. Each Experiment was repeated thrice with six replicates per treatment of 20 seeds on each Occasion. The data were statistically analysed for LSD at 95% confidence limits (Pause and Sukhatma, 1967) [21].

**E. Total Net Primary Productivity (TNPP):**
“Difference Method” of Ovington et al., (1963), [17] was employed for calculating TNPP where the positive difference in total plant biomass at subsequent sampling dates or harvest days were summed up. NPP was calculated for total plant biomass.

**IV. Results And Discussion**

**Total Net primary productivity (TNPP):** The Net Primary Productivity (NPP) of C plants recorded at 21-51, 51-81 and 81-95 day growth period was 3.476, 11.055 and 2.121 g/plant respectively.

![Figure 2: Net Primary Productivity during different Harvest periods in Soils Amended with ISW Weight (g/Plant)](image)

**V. Conclusion**
The NPP values for C plants increased from 21-51 day period to 51-81 day period and thereafter declined. The same trend was evident in the plants from A1, A2, A3 and A4 soils. However, when compared with that of the C plants, the TNPP reduced significantly in A1, A2, A3 and A4 soils during 21-51 days and the decrease has ranged from 42% in A2 soil to 77% in A4 soils. The data relating to TNPP are presented graphically in Fig 2.

Proper methods of Industrial solid waste disposal have to be undertaken to ensure that it does not affect the environment contamination around the area or cause health hazards to the people, Flora and Fauna living there. The results of the present study urge further research on all agricultural crops grown in the surroundings of the solid waste dumpsites of all industries in different regions and soils. The results indicate that abnormal levels of Cu, Zn, Fe and Mn, capable of causing health hazards to the consumers. The results of this study stress the need for environmental awareness, adequate regulations and proper management of waste sites by the local municipal authorities. There is a need to check industrial solid waste by implementing strictly the pollution control laws and strict control on the disposable of Industrial solid waste around the industries needs to be enforced. High concentration of heavy metals and other hazardous substances in the Kakinada city in particular need to be evaluated.

**VI. Recommendations**
1) Urban local bodies should identify the areas from where industrial solid waste is generated.
2) Urban local bodies may undertake collection, transportation and disposal of solid waste on cost recovery basis as per existing rules and may identify suitable sites for final treatment and disposal of industrial solid waste as per existing rules and regulations.
3) Screening of all agricultural crops to understand their response to the ISW contamination and also make necessary strategies to advise the farmers.
4) Encourage research on remediation of ground water, Soil and Industrial solid waste contaminated sites in industrial area of Kakinada.
5) Pollution control boards needs to take necessary to control the Industrial solid waste on the disposal areas.
VII. References


VII. Acknowledgements

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