ABSTRACT

Heavy metal pollution becomes serious problem because it not only affects the production and quality of crops but also influences the quality of the atmosphere, soil texture and threatens health of animals and human beings. The phytoremediation investigations have been performed by using selected varieties of plant species to survive in phytotoxic environments that contain unusually high concentration of heavy metals. For effective phytoremediation process the plant species should be non edible and which can be grown abundantly in large scale on wastelands. Amendments such as biofertilizer play an important role in establishment of plant on contaminated land so the aim of the study was to evaluate the effect of Azotobacter biofertilizer in planting conditions of Jatropha curcas for reclamation of metal contaminated soils. Survival rate of plants in heavy metal contaminated soil increased with addition of amendments and metal contaminated soils could be suitably remediated by adapting appropriate phytoremediation measures.

KEYWORDS BIOFERTILIZER, JATROPHA CURCAS, PHYTOTOXIC, PHYTOREMEDIATION, AZOTOBACTER

INTRODUCTION

Natural environment pollution caused by heavy metals is a universal problem because these heavy metals are indestructible and most of them have toxic effects on
living organisms when permissible concentration levels are exceed. Heavy metals frequently occurrences in contaminated soils are Cd, Cr, Pb, Zn, Fe and Cu (Akoto et al., 2008). Heavy metal pollution becomes serious due to mining, mineral, smelting and tannery industries (Wang et al., 2001). Recently, numerous efforts have been undertaken to find cost-effective technologies for remediation of heavy metal-contaminated soil (Chatterjee et al., 2011). Therefore, plants can be used to ameliorate heavy metal pollutants from the soil this cost effective approach is called phytoremediation which also referred as green solution (Butcher et al., 2009).

The purpose is the remediation and reclamation of degraded lands or soils that contains unusually high concentration of heavy metals. For long term remediation, metal tolerance plant species are commonly used for revegetation of degraded lands (Lan et al., 1997). The physiochemical properties of heavy metals contaminated soil tends to inhibit plant growth (Sopper et al., 1993). The quantity and activity of microorganisms represent sensitive indicators related to plant height, number of leaves, root length and biomass development processes. Therefore, the amendments such as organic materials and biofertilizer play an important role in establishment of plant on metal contaminated land.

For effective phytoremediation process the plant species should be non edible and which can be grown abundantly in large scale on wastelands. Considering all the options available among non edible Jatropha curcas has been selected for this experiment. To improve the growth of biodiesel plant on different concentration of heavy metal contaminated soils such as lead, zinc and chromium amended with biofertilizers. Biofertilizers have emerged as an important component of the integrated nutrient supply system and hold a great promise to improve crop yield through environmentally better nutrient supplies (Marianna et al., 2005).

MATERIALS AND METHOD

Isolation of Azotobacter from soil using Nitrogen free minimal media (Thompson and Skerman, 1979)

After collection of soil 1gm of soil was weighed and dissolved in distilled water to make stock. From the stock ten different dilutions up to $10^{-10}$ was prepared. Now dilution $10^{-4}$, $10^{-5}$, $10^{-6}$, $10^{-7}$ are poured into petriplate and then medium was poured. The plates are allowed to solidify, after solidification the plates were incubated at 37ºC for 3-4
days. After incubation colonies were appeared. Mucoid colonies were picked up and then gram staining and biochemical analysis was done.

**Biochemical analysis of Azotobacter**

Biochemical analysis include indole test, Catalase test, MR-VP Test etc. The nutrient broth was prepared and then a loopful of bacterial culture was inoculated into it. The flask was then incubated at 28°C at 120rpm for 5-7 days at shaker Incubator.

**Binding and packaging**

Lignite coal was taken as a carrier and crushed to fine powder and the filtered. Now the broth culture was poured over sterile powder and mixed properly. The ratio of coal and broth culture should be in 1:2 and finally it was kept for 10 to 12 hours.

**Contamination of soil and establishment of pot experiment**

Pots with soil were taken and then Jatropha curcas plants were planted. Pot with plant without heavy metal and Biofertilizer was taken as control and remaining pots were taken as plant with heavy metals and biofertilizer. Pots named as T1, T2, T3 etc were treated heavy metal including Ar, Cr, and Zn with biofertilizers.

**Calculation of The tolerant index**

The tolerant index of the plants to As, Cr and Zn were calculated by the following equation:

\[
\text{Tolerant index} = \frac{\text{Mean height of the plant growing on metal contaminated soil} \times 100}{\text{Mean height of the plant growing on garden soil alone without metal}}
\]

**RESULTS AND DISCUSSION**

The results of the pot experiment conducted over one month to study the growth performance of the plant showed that the Jatropha was survived in Arsenic, chromium, zinc contaminated soil up to 100 mg/kg respectively. This survivality of plant in the heavy metal contaminated soil is due to biofertilizer application. Result in the present experiment demonstrated that the biofertilizer greatly enhanced the growth of Jatropha curcas plant. Present experiment with different treatment showed growth performances in ascending order as T4 → T3 → T2 → T1.
Table 1 % Tolerant index of *Jatropha curcas* in different treatments of arsenic, chromium and zinc contaminated soil

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Metal in soil (mg/kg)</th>
<th>Tolerant index without Biofertilizer</th>
<th>Tolerant index with Biofertilizer</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Ar 50</td>
<td>60</td>
<td>66</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>50</td>
<td>45.5</td>
</tr>
<tr>
<td>T2</td>
<td>Cr 50</td>
<td>50</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>40</td>
<td>59</td>
</tr>
<tr>
<td>T3</td>
<td>Zn 50</td>
<td>97</td>
<td>98</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>100</td>
<td>108</td>
</tr>
<tr>
<td>T4</td>
<td>Control</td>
<td>Plant without heavy metal and Biofertilizer</td>
<td></td>
</tr>
</tbody>
</table>
CONCLUSION

Pot culture experiment has demonstrated that biofertilizer are effective in plantation of *Jatropha curcas* in heavy metal contaminated soil. From the above experiment result we conclude that biofertilizer enhances the growth of *Jatropha curcas* in phytotoxic environment. The findings of above work have shown that heavy metal contaminated soil can be restored with utilization of biofertilizer as an amendment. Remediation of heavy metal pollution in environment to avoid its threat is very urgently needed. Therefore it is concluded that remediation and reclamation of degraded lands and soils that contains usually high concentration of so called heavy metals can be done by application of biofertilizer.

REFERENCES


