MANAGING EFFLUENTS FOR TREE ESTABLISHMENT AND SAFEGUARDING OUR ENVIRONMENT

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Increasing population in urban areas and the consequent industrialization draw a large quantity of our precious water resources and finally provides us a by product, what is called wastewater or municipal effluent. Both the need to conserve water and to safely and economically dispose of wastewater, make the use of effluent in tree plantation as a very feasible option. Furthermore, wastewater reuse reduces fertilization rate and provide a low cost source of irrigation water. Trees and shrubs are the better alternative to dispose of municipal effluent because of their high growth rates and potential to produce high biomass on annual basis, ability to sustain very high loading rate, no direct link with food chain and profused root system to control leaching and salinity and toxicity of the soil. Industrial effluent vary in chemical composition depending upon the type of raw material used and may be toxic to the environment/ vegetation and require considerable attention while disposing of these effluents, whereas municipal effluent has little variability and may act as source of fertilizer. Appropriate managements/treatments of these effluents may be provided for their use in raising tree plantation to solve the problem of fuel wood supply in sub urban areas, which ultimately reduce the pressure from degraded forest areas as well as use of potable water in irrigating forestry plantations. To verify these three experiments were carried out including a pot culture, a lysimeter and a short tern field experiment. In short tern field experiment, textile effluent was applied at the rate of 30 liter per plant at monthly interval in winter (October to February) and fortnightly in summer (March to June). Different treatments were: W_1- irrigation with effluent only; W_2- irrigation with effluent mixed with canal water in 1:1 ratio; W_3- irrigation with gypsum treated effluent; W_4- Soil treated with gypsum, and W_5- soil treated with wood ash. In W_3 treatment, effluent was left for 24 h after gypsum treatment and the plants were irrigated next day. In pot culture experiment, textile, municipal and effluents released from iron rolling mills were applied as such as well as under mixing to each other, whereas in lysimeter experiment, municipal effluent was applied at different dosing rate.

 

Fig 1. Effluent discharge from industries and environment degradation (left); established plantation using municipal effluent in in-filled non-weighing type of lysimeters in experimental field of AFRI, Jodhpur.

In the short term field experiment, *P. juliflora* performed best with textile effluent whereas *A. nilotoca* and *A. lebbeck* were the unsuitable species. Survival of *A. indica* was highest followed by *P. juliflora*. Among the management practices, soil treated with wood ash was the best performed followed by soil treated with gypsum. W_3, W_2 and W_1 did not differ. The performances of the plants under treatments regime of W_5 could be attributed to the nutrient effect of ash. After 28 months of field experiment no toxicity had been observed on the trees seedlings.

Irrigation with effluent from steel rolling mills and its mixture with textile effluent and municipal effluent decreases soil pH, organic carbon, basic cations and nutrient and increased metals availability resulting mortality of *D. sissoo* seedlings within a day and those of *A. nilotica* and *E. camaldulensis* within two days in under steel effluent irrigation. Survival time of seedlings increases under mixing. Irrigation with textile effluent enhances soil soil pH, EC and Na concentration but decreased Mg, Cu, Fe, Mn and Zn concentration resulting in leaf chlorosis and defoliation, whereas irrigation with municipal effluent and a mixture of textile and municipal effluent had positive influence on soil Mg and micronutrient concentration and the seedlings were without any adverse effect.

In lysimetric study application of municipal effluent at ½ PET and canal water at 1PET produced same biomass at the age of 2 and 3 years when water requirement of plant was less- saving of half of the quantity of canal water for drinking purposes. Some of the results of municipal effluent applications are as below:

- At the age of 4 years: *E. camaldulensis* produced dry biomass of 20.1, 15.5 and 9.7 kg plant^{-1} by irrigating seedlings with municipal effluent at the rate of 2 PET, 1PET and ½ PET, respectively; *A. nilotica* produced 13.3, 10.5 and 7.9 kg plant^{-1} by irrigating seedlings with municipal effluent at the rate of ½ PET, 1PET and ½ PET, respectively; *D. sissoo* produced 14.8, 10.5 and 9.1 kg plant^{-1} by irrigating seedlings with municipal effluent at the rate of 2 PET, 1 PET and ½ PET, respectively; seedlings of *E. camaldulensis*, *A. nilotica* and *D. sissoo* irrigated with canal water at 1PET produced 11.3, 9.0 and 9.9 kg plant^{-1}, respectively; and eeedlings irrigated at 2PET produced same biomass as obtained from 78 months old seedlings under rainfed.

- Added nutrients through municipal effluent application enhanced the CO2 assimilation and transpiration and thereby biomass production.
- High photosynthesis and transpiration rate was observed in *E. camaldulensis* whereas in growing months of March-April and July- August rate of photosynthesis was highest in *D. sissoo* and rate of transpiration rate was highest in *A. nilotica* seedlings.
- Plant nutrient concentration increased with the quantity of municipal effluent. Non-significant changes in ratios of different nutrients in leaves of municipal and canal water irrigated seedlings suggest beneficial effects except the irrigation at 2PET level
- Low N/P and N/Mg and high Mg/Na, Mn/Zn and N/Na ratio in the seedlings irrigated at 2PET level as compared to the corresponding values in the seedlings of 1 PET canal water treatment indicates that higher level of municipal effluent application may be critical in long-term application.
- Comparatively less nutrient status in the soil with plants as compared to that the bare soil of suggest beneficial effect of plants in soil remediation; High accumulation of NH_4-N and PO_4-P needs management either their removal before their application or enhance mineralization.
- Application of municipal effluent was found better option rather than its direct disposal to land as plants accumulates nutrients added to soil and ameliorate the soil conditions.
- Potential use of municipal effluent for growing tree seedlings in favour of biomass production in thirsty and nutrient poor soil of dry area enhances its aesthetic and environmental benefits in suburban area.

Conclusion and recommendations

Municipal effluent can safely be utilized in irrigating tree plantation having no direct link with food chain. However, concentration of NH_4-N and PO_4-P may be reduced to a minimum level to avoid any toxic effect in long-term application. Application at 1PET level will be better both environmental and economic point of view. We can increase the interval of application with cumulative quantity of effluent if high loading rate is not necessary. However, we have to take care about application of industrial effluent, which vary in chemical composition and generate toxicity in plants leading to mortality as in case of effluent released from iron rolling mills.

Selection of suitable species tolerant to a particular type of effluent for phyto-accumulation of metals/mineral or phtoremediation of soils already degraded under uncontrolled disposal of these effluent may be another options.

References for further readings

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