| ISSN: 2395-7852 | www.ijarasem.com | Bimonthly, Peer Reviewed & Referred Journal|

| Volume 9, Issue 6, November 2022 |

Study of Fertilizer Utility of Distillery Effluents on Soil Plant Relationship and Growth Metabolism of Certain Crop Plants (viz. *Oryza sativa*, *Helianthus annus*)

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ABSTRACT: The disposal of distillery eftluents is a problem of increasing importance throughout the world. In Indi a, a huge amount of waste water generated from distillery industries is discharged on land or into the running water. Distillery waste water is characterized by low pH, high BOD and COD values and contains a high percentage of organic and inorganic material s. This waste water also contains considerable amoun ts of elements like N, P, K, Ca and S. The distillery effluents are characterized by high values of BOD, COD and wide range of pH, depending upon the sou rce of origin. The N, P and K contents are lower as compared to those in distillery waste waters. Impact of use of these effl uents on soil, plant and waterbodies is discussed. Use of distillery effluents indicates a significant increase in elec trical conductivity (EC), organic carbon, exchangeable Na as well as avail ab le N, P and K in soils. Similarly, pH , organic carbon, cation-exchange capacity, available N, P, K and micronutrient contents of soils irrigated with distillery effluents are reported to be increased. Besides, the use of this waste water increases the exchangeable Na content of soils. Some of the field crops show positive response to post-methanation eftluent applicat ion with irrigation water.

KEYWORDS: distillery effluents, industries, waterbodies, soil-plant relation, growth, *Oryza sativa*, *Helianthus annus*

I.INTRODUCTION

Various studies report the effects of irrigation of a sodic soil with post methanation effluent (PME) of a distillery. Impact of long term effluent irrigation in the field (10 years)[1] and short term effluent irrigation using different doses of PME in the laboratory (30 days) was studied in combination with three bioamendments i.e. farmyard manure, *Brassica* residues and rice husk. Impact on various soil properties like EC, pH, total organic carbon (TOC), total Kjeldahl nitrogen[2] (TKN), available phosphorus, exchangeable K, Na, Ca, Cl, microbial population and soil enzyme activities were studied. Long term application of PME proved useful in significantly increasing TOC, TKN, K, P and soil enzymatic activities in the soil but tended to build up harmful concentration of Na, that could be chelated by bioamendments.[3] In short terms studies, application of 50% PME along with bioamendments proved to be the most useful in improving the properties of sodic soil and also favoured successful germination and improved seedling growth of *Oryza sativa* and *Helianthus annus*. Most of these studies have, however, been conducted on normal agricultural soils while there are very few reports on impacts[4,5] of effluent ferti-irrigation of salt-affected . Salt-affected soils are of widespread occurrence in most of the arid and semi arid regions where scarcity of water warrants optimal utilization of any available water resources.[6,7] Thus, use of industrial wastewater for irrigation purposes in such soils needs to be explored. Salt-affected soils of these regions are poor in organic carbon. Hence, addition of distillery effluent, which is rich in organic matter, is likely to improve the fertility of such soils. However, it is extremely important to examine the effects of such distillery wastewater applications on various physico-chemical and biological properties of the soil as well as on crop growth and yield. It is also very important to see if long-term effluent irrigation leads to further salinity build up or elevation of soil pH. Distilleries producing huge quantities of foul smelling wastes[8,9] (effluents) are recognised as one of the most potential agro-based industries in India. However, these distillery effluents contain organic and inorganic nutrients and have been reported to have a beneficial effect on crop yields viz. *Oryza sativa* and *Helianthus annus*.[10] Distillery effluents contain organic and inorganic nutrients and have been reported to be beneficial in increasing the crop yields . This industrial discharge is rich in organic and inorganic matter and serves as an excellent source of plant nutrients (N, P, K, S etc) Besides, it may contain some toxic compounds as well, that may suppress the soil properties and plant productivity. After proper primary and secondary treatment processes, the wastewater can be essentially acts as a soil fertilizer and utilized for crop irrigation purpose. There present several studies that advocated the adequacy of distillery effluent in enhancing the productivity and agronomic value of various crops[11] .However, a proper compositional characteristic of distillery effluent may play crucial role in deciding the productivity of the agricultural system. Therefore, there is an urgent need to study usage pattern of industrial wastewater that safeguards soil physical and chemical conditions and enhances soil productivity. But prior to recommendation of such industrial effluents for land irrigation and crop

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production the toxicological impact of industrial effluent of commercial plant should be assessed viz. *Oryza sativa* and *Helianthus annus[12]*

II.DISCUSSION

It has been noticed that in all studied crop plant (*Oryza sativa* and *Helianthus annus*) the shoot biomass contributes more and was comparatively higher than that of root biomass. Also the pigment concentration in the respective plant plays a very crucial role in deciding the normal well being of the plant . The pigment concentration is directly correlated with the photosynthetic activities of the plant, which later govern the biomass production . The results suggested that effluent with 20% strength when used for irrigation purpose seems to be beneficial for plant germination and growth. This was in accordance to the results of experiments which also states that post distillery effluent irrigation lead to increases in chlorophyll and protein contents in *Oryza sativa* and *Helianthus annus* at the lower concentrations (25% and 50%) of distillery effluent followed by a decrease at higher concentrations (75% and 100%) of distillery effluent .[13,14]

Use of distillery effluents for irrigation purposes is a highly warranted utility of water pollutants proposition. The objective of using waste water for irrigating crop plants is of two fold. The first and foremost of this is the safe disposal of the distillery effluents, which may otherwise have adverse effects on the environment and human health. The other objective is to recycle it as irrigation water, as compost for its possible fertilizer value. Distillery spent wash is a potential source of renewable energy. It does not contain any toxic heavy metals and being of plant origin and because of its rich nutrient contents may serve as a good fertilizer for crops, more effective than inorganic or mixed fertilizers being used by farmers. Distillery effluents were once regarded as the most highly polluting effluents. The energy, fertilization and irrigation potential of distillery effluents has helped the industry to build immense social acceptability now. Distillery effluents are a rich source of Nitrogen, Phosphorous and Potassium. Potassium is the most richly represented. It also has appreciable quantities of micro nutrients. Being organic in nature, the nutrients are more rapidly taken up by plants from soil. They also contain large amounts of Ca, Mg, Na, S and Chlorides which can be used as a resource for crop production and reduce the use of inorganic fertilizers. It has been stated that alternate methods of clarification in place of “Milk of Lime” in Sugar Mills may improve the quality of molasses by reducing Potassium and Sodium, rendering the usability of bio methanated spent wash (after further treatment) for agricultural applications. Some authors have observed that spent wash irrigation may also lower the incidence of insect pests.[15,16] Distillery effluents have been found to be more effective than a mixture of inorganic fertilizers and cow dung manure. The current technologies of concentration incineration and concentration need heavy expenditure and the potash and other salts present may create a fouling in the evaporators and boiler heat transfer sections. The rich organic and inorganic constituents allow it to bring remarkable changes in the physical, chemical and biological properties of soil. Distillery effluents are used as a supplement to mineral fertilizer .The use of Urea mixed distillery spent wash is widely prevalent as a single application. Post methanated spent wash application to growing crops is discouraged, instead land application before planting is suggested to be a better option. The spent wash is blended with additional crop nutrients and sold as manure.[17,18] Spent wash could also be used for composting the trash in fields. Nutrients present in the Vinasse and those obtained from the supplements in the anaerobic treatment can be recycled by using the effluents in fertigation and sludge for plant fertilization. Although Fertigation is the most feasible option for the management of stillage but the intensity of impacts depends on the characteristics of the soil and climate of the fertigated area. Appropriate time, space and rate of application of vinasse in agriculture has added significant amount of nutrients, improved the soil quality of degraded lands and increased crop yields. However, detailed management plans have been recommended to be drawn up.[19]

III.RESULTS

It has been claimed that the 290 odd distilleries in India produce 40 billion liters of effluents (spent wash) per annum with an annual value of Rs. 500 crores in terms of N, P, K, and S; 150 crores for micro nutrients and organics; a Rs. 100 crores saving in the annual environmental cost; Rs. 100 crores in terms of loss to fisheries; 500 crores savings in water treatment costs, 100 crores in public health and another 100 crores in landscape costs. Energy savings in respect of the secondary and tertiary systems of treatment could be as high as Rs. 1400 crores per annum. In downstream moral areas of India waste water supports annual agriculture production worth Rs. 266 million.By using spent wash at different levels some authors have observed a substitution of 40-90% of the inorganic fertilizer cost[20]. Some have also observed that in terms of Presown land application followed by irrigation, net returns in the treatment with only potassic fertilizer was Rs. 64630/- per ha and increased to Rs. 76183 per ha due to substitution of 50% of recommended dose of Potassium with spent wash. Spent wash application above 50% level was not beneficial. Distillery effluents have been observed to bring about increases in yield indicators for *Oryza* and *Helianthus*.[18,19] These both plants has been observed to withstand the application of concentrated distillery effluent without showing reduction in yield instead application of spent wash has been observed to bring about an increase in the yield. Long duration crops may need nutrients over a longer period of time. Spent wash meets the long term requirement for nutrients. Biomethanated spent wash application has found to enhance the yield in maize also. A need to balance nutrients by supplementing with other fertilizers has also been suggested. The application of spent wash has not only benefited the rice and sunflower crops in supplying nutrients throughout its growth period but also favoured the growth of microbial biomass. It has generally been established that crop nutrition through chemical fertilizers is inferior to spent wash irrigation. Sunflower, soybean and grasses and rice have all responded positively to spent wash irrigation. The application of digested spent wash to the soil either along with irrigation or as soil amendment has a beneficial effect on soil nutrients thereby increasing the uptake of nutrients by the crop[17,18] and ultimate increase in crop productivity. Along with irrigation water, lower concentrations suitably supplemented with N and P appear to be more beneficial than higher concentrations. Positive yields in crop productivity have been observed in pulses. In oil seeds an increase in the protein and oil content has also been reported. Some countries have reported an increase of 45-100% in the yield of rice, sunflower etc using distillery effluents. The application of spent wash has also been demonstrated to be beneficial for the worms and insects that are essential for germination and nutrient availability. Distillery effluents have been reported to significantly increase the grain yield in maize. An ideal application was a conjunctive use of spent wash along with chemical fertilizer better than only spent wash or only chemical fertilizers.[15,16]

IV.CONCLUSIONS

Distillery waste application in agriculture improves the uptake of nutrients from the soil. Distillery effluents used by themselves or as supplements to other fertilizers (N and P) has resulted in the increased uptake of N, P, K, Ca and Mg from soil. Leaching of nitrate from the soil was also reduced when distillery residues were used in soil. Some authors have also observed that the application of diluted spent wash increased the uptake of Zn, Cu, Fe and Mn. Higher uptake levels have been reported at lower dilution levels. Mineralization of organic matter and nutrients in soil has been held responsible for the increased uptake. Hence distillery effluent have proved to be beneficial to plant growth and development eg. *Helianthus annus* (Sunflower) and *Oryza sativa* (rice).[19,20]

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