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EFFECT OF DAIRY EFFLUENTS ON SEED GERMINATION AND EARLY SEEDLING GROWTH OF PENNISETUM TYPHOIDES

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INTRODUCTION

Industrialization during 19th century changed mankind's life style. New technology raised man's standard and made life more comfortable but with increasing industrial development, safe disposal of industrial waste water has become the more ecological challenge. Environmental degradation has now become a global problem and maintaining ecosystem health is a serious issue being confronted by the environmentalists. Due to lack of effluent treatment facilities and proper disposal system of waste water, water bodies are getting polluted day by day and causing adverse effect on soil, water, agriculture, flora and fauna due to presence of toxic and persistent chemicals. As the problem of waste disposal has now attained complex dimensions, it becomes essential either to find suitable ways for the safe disposal of these wastes or to suggest novel use, considering them as by- products. Otherwise these will remain as accumulated wastes, contributing significantly to the environmental pollution. In the absence of uses for the waste materials there are added costs for building and maintaining the lagoons of these wastes. Finding a profitable use for this waste could further benefit the economics of the industry.

Ever shortening water resources, shrinking ground water table and increasing per capita cost of agriculture productivity have not only drawn down the production budget but also questioned the future food security and agriculture sustainability at low input basis. Industrial effluent contains a high concentration of plant nutrients and can be effectively utilized as liquid bio- fertilizer for the soil restoration and sustainable land production. In recent years, much attention has been paid to utilize the industrial effluent after certain physical and chemical treatment for agriculture land application.

Apart from heavy Industrial Units, many small scale industries release their effluents in environment. Effluents released from pulp and paper mills, fertilizer factories, distilleries, food processing units like dairy industries are released in to the environment, which is fast

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transforming air, water and soil in to big natural reservoirs of dangerous pollutants (Hodges 1973).Of these soil has a great capacity for receiving and decomposing wastes and pollutants of different kinds. Soil are thus efficient purifying media as suggested by Robeck et al., 1963; Bouwer, 1970; De Vries, 1972 and Young et al., 1975. Among these industries, food processing industrial effluents released from the dairy industries are rich in various kinds of nutrients like phosphate, calcium and magnesium etc and has good potential in utilization of released effluents as a source of nutrients for the crops plants.

REVIEW OF LITERATURE

In view of the various facts of the problem, as mentioned in the introduction, the pertinent literature on different aspects of the subject under study is reviewed as under:-

Physico- chemical properties of dairy effluent:-

To study the effect of various industrial effluents, it is essential to determine the physico-chemical composition of different organic industrial and municipal wastes/ effluents in a given area. This information, however, many a times is found lacking in developing countries for many of the industrial and municipal wastes. Composition of a few sewage waters were analysed by Arora et al.,1985; Gupta et al., 1986, 1987; Yamaura et al., 1986; Abd Elnaim et al., 1987; Neis et al., 1987; Waly et al., 1987, Omran et al., 1988. Patric, 1953; Ghosh and Basu, 1968; Verma and Shukla, 1969; Verma and Dalela, 1975, 1976; Verma et al., 1978; Sheehan and Greenfield, 1980; Sahai et al., 1985; Srivastva and Sahai, 1987 and Verma et al., 1989 observed the composition of molasses distillery effluents whereas the analysis of paper mill effluent was done by Khambatta and Ketkar, 1977; Narum et al., 1979; Juwarkar and Subrahmanyam, 1987.

Studies were also made on oil refinery effluent (Miskovic et al., 1986; Petrovic, 1986; Dalmacija et al., 1986; Chin et al., 1986,1987), glue waste (Loehr,1974) and fly ash (Mulford and Martens, 1971; Von Lehmden et al., 1974; Plank and Martens, 1974; Block and Dams,1975; Swaine, 1977; Kamath, 1979; Khemani et al., 1980; Mishra and Shukla, 1986; Srivastva et al., 1986; Shukla and Mishra, 1986; Cerevelli et al., 1987; Petruzzelli et al., 1987; Wadge and Hutton, 1987; Aggarwal et al., Singh and Gupta, 1989).

Matkar and Gangotri (2002) studied the physico-chemical analysis of sugar industrial effluents and found that the sugar effluent concentration is 43000 mg/ l for B.O.D. and 89760 mg/ l for C.O.D. These are beyond the tolerance limit of the water causing shifting of the algal forms towards more tolerant zone leading to decrease in biodiversity. Total solids, total dissolved solids and suspended solids were also considerably high. Pandit and Prajapati (2003) studied the physico-chemical property of chemical and dairy effluents near Bhavnagar, Gujarat and found that these effluents contain number of elements, which were useful for crops. Chemical industry

effluent contains high amount of metals like Fe, Cu, Zn, Mn, Bo, Cd, Cr and Se, while they were absent in dairy effluents.

Effect of effluent on plant growth:-

Effect of various industrial effluents like oil refineries, food processing industries, pulp and paper industries on the seed germination and various parameters of plant growth and yield have been noted earlier by many scientists.

A linear decrease in germination and growth of seeds was noted in case of studies related to effluent containing harmful chemicals released from petroleum refinery, paper board industry, ordnance factory and chemical industry. Bossert and Bartha (1985) reported decrease in seedling emergence with increasing dose of oily sludge, which contained excess of methylene chloride. Ahmad et al. (2003) studied the response of sugarcane (Saccharum officinarum) crop grown at the agricultural farm of the Mathura Oil Refinery in a simple randomized block design. The plants gave better response to the treated wastewater (TW) than the groundwater. The soil receiving wastewater did not show any significant change in its physico- chemical characteristics. The soil accumulated all the heavy metals but the plant samples receiving TW only exhibited the present of Ni, Pb and Zn whose values are far below the permissible limits. Similarly Hayat et al. (2002) studied the long term effect of oil refinery wastewater (TW) on crops yield, heavy metal accumulation in soil and crop produce. Results indicate that the level of nitrate, phosphate, potassium, calcium, magnesium and sulphate in wastewater is comparatively more than the ground water. The seed yield in mustard and wheat, irrigated with TW, was more than that with ground water.

Narasimha Rao et al. (1992) studied the quality of effluent water discharged from paper board industry and its effect on alluvial soil crops. They found that effluent water could be safely used for irrigation of rice and cotton on alluvial soil having loamy to sandy- loam texture. But irrigation of tobacco and chillies with this effluent water led to poor-quality produce and reduced crop yield. Dutta et al. (1997), Baruah et al. (1998) carried out a study to investigate the effect of effluent of the Paper Mill on the germination of rice (Oryza sativa L. var. Masuri) seed and subsequent growth of seedlings. The study has revealed that effluents particularlly at higher concentrations inhibit germination and growth of seedlings. Further, it has been seen that rice seeds collected from effluent affected area are less viable and even the viable seeds show delayed germination in comparison to the one collected from control areas. Singh et al. (2002) made the assessment of agro potentiality of the effluent coming out from Century pulp and paper mill, Ghanshyamdham, Lalkua (Uttaranchal) on wheat (Triticum aestivum var UP-2329) crop grown in two soils differing in texture with different effluent concentrations. Diluted effluent increased the chlorophyll content, plant height, shoot and root biomass, grain yield, protein, carbohydrate and lipid contents in wheat grains, while undiluted effluent caused inhibition in

plant growth resulting in a sharp decline of yield.

Srivastava et al. (1995) studied the effect of ordnance factory effluent on seed germination and early growth performance of pea seeds. It was found that the ordnance factory effluent was highly deleterious for the germination and early growth performance of seeds and as the concentration of effluent increases the deleterious effect also increases thereby showing positive correlation. Chidaunbalam et al. (1996) tested the suitability of treated effluent of a chemical industry on germination and growth of Vigna radiata and Vigna mungo. The diluted effluent (10% v/v) was found to be effective in promoting germination, growth, chlorophyll and protein content. The study suggests that this effluent may be used for irrigation after suitable dilution.

Fly ash released from Thermal Power Plants also plays a significant role in plant growth and biomass. A linear decrease in emergence and growth of soyabeen seedlings with increasing fly ash concentrations was also observed by Shukla and Mishra (1986) and Srivastva and Sahai (1987) respectively. Twenty per cent decrease was at 3 and 15 per cent concentrations of these wastes, respectively. There was no yield at 100 per cent concentration. Dry matter yield in wheat seedling increased with increasing fly ash concentrations up to 5 per cent in an acidic soil of pH 5 in Italy Petruzzelli et al. (1987). Almost similar types of results were noted by Karpate and Choudhary (1997). They studied the effect of thermal power station's waste i.e. fly ash and fly ash water on Triticum aestivum Var. Kalyan Sona. Plants were either irrigated with 25%, 50%, 75% and 100% fly ash water or grown in 50%, 70%, 90% fly ash amended soil. At lower concentrations the fly ash water and fly ash had stimulatory effect on the crop. However, at higher concentrations the treatment showed deleterious effect. Moreover, all concentrations of fly ash water and fly ash were found to have damaging effect on cytology and genetic material. Tripathy and Sahu (1997) conducted a pot experiment to study the effect of the Talcher Thermal Power Station fly ash on growth and yield of wheat. Data of the pot experiment on growth and yield reveal that 50% fly ash applied to soil increased seedling height, plant height, girth, leaf number, leaf area, spike length, dry weight etc. The soil application of fly ash not only has the potential for improving their production but also for solving of the fly ash disposal problem. Singh et al. (2003) conducted a 120 day greenhouse experiment to study the effects of various fly ash concentrations (0%, 20%, 40%, 60%, 80% and 100% vol/ vol) with normal field soil and Helminthosporium oryzae on the growth and yield of three cultivars of rice, Oryza sativa (L.). Application of 20% and 40% fly ash with soil caused a significant increase in plant growth and yield of all the three cultivars. Forty per cent fly ash caused a higher increase in growth and yield than did 20%. Sixty per cent, eighty per cent and hundred per cent fly ash had an adverse effect on growth and yield of all the three cultivars, the maximum being with 100% fly ash.

Research Methodology

Today environmental degradation has become a global phenomenon. With the growing

industrialization and urbanisation many areas face severe shortage of water while others may face it in the years to come. Industrialisation boost the economy of the country on one hand and on the other hand act as threat to environment. Most of the effluents contain varied groups of chemical compounds including nutrients. These nutrients help in fertilization of soil and would also increase productivity of the land (Rajanan and Oblisami 1979, Bishop 1986, Sahai et al 1986, Swaminathan et al 1995). As Haryana is a well developed industrial State and have rich potential of food processing industries like fruits and vegetable processing, dairy processing, meat, poultry processing, edible oil, alcoholic beverages and non alcoholic beverages, grain processing industries etc. Controlled use of the waste water released from these industries can provide substantial ecological and recreational benefits (Merz 1956, Day et al 1972, Gorden et al 1975). Dairy industry is important in the collection of the milk from milk producers and distribution of milk and other milk products. In India, there are hundreds of processing units for the production of various milk products such as butter, ghee, ice- cream, condensed milk and milk powder etc. During processing of milk and its products, large quantity of waste water is generated, which contains variety of organic chemicals. The recycling of this water for the agriculture fields may reduce the contamination of soil due to the presence of large amount of waste water (Bansal 1986, Siebe and Cifuentes 1995). Soil has a great capacity for receiving and decomposing wastes and pollutants of different kinds. Soils are thus efficient purifying media, as suggested by Robeck et al. (1963), Bouwer (1970), De Vries (1972) and Young et al (1975). The present study deals with the effect of dairy effluent on the crop Pennisetum typhoides (L.).

The main objectives of the present study are (1) Analysis of soil and dairy effluent for various physico- chemical parameters. (2) To study the effect of dairy effluents on germination percentage of pearl millet seeds in various concentrations of effluents (20%, 40%, 60%, 80%, 100% and Control) in laboratory in petri plates. (3) To find out length of plumule and radicle and their ratio in various concentrations of effluents and in control in lab conditions. (4) To find out the effect of dairy effluents on fresh weight and dry weight of germinated seeds. (5) To analyse the effect of different concentrations of dairy/ milk plant effluent on vegetative growth of pearl millet in both compost rich and compost free soil. (6) To find out the root length, shoot length, root/ shoot ratio, number of leaves and internodal lengths of plants under various concentrations of milk plant effluent in compost rich and compost free soil.

The main scope and relevance of the present study is that, as most of the industrial effluents are rich in pollutants and are harmful for the plant growth but effluents from food processing industries like fruits and vegetable processing, dairy processing, meat, poultry processing, grain processing industries etc are rich in nutrients like carbohydrates, minerals and nitrogenous compounds and enhance the plant growth when supplied in optimal concentrations. The present study has much relevance regarding the effect of milk plant effluent on crop plants as Haryana state has lots of milk plants like Vita Milk Plant, Sirsa; Vita Milk Plant, Jind etc.

The crop, pearl millet was taken for the study because it is one of the most important crop grown in the south western Haryana. Results of the study may be utilized by the farmers of that area.

To carry out the study, milk plant effluent was collected from Vita Dairy/ Milk plant, Sirsa in plastic containers. Government certified seeds of Pennisetum typhoides (Var. HHB-67) were taken from registered shop of seeds (Haryana Development Seeds Corporation). Soil was collected from field of Balsamand Area, Hisar from a depth of 0- 15 cm. After this the process of its drying, crushing, sieving, weighing etc was done. Then the physico– chemical analysis of soil was done for its various parameters. Fully decompost vermicompost was collected from department of Agronomy, CCSHAU Hisar. After that physico– chemical analysis of dairy/ milk plant effluent was done for its various parameters.

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