

# EFFICIENCY OF UNTREATED AND TREATED DAIRY EFFLUENT ON PHYSICO-CHEMICAL PROPERTIES OF THE SOIL

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**Abstract** : Samples of untreated and treated dairy effluent were collected from Parag milk plant, Meerut. Three concentrations (25, 50 and 100%) were used in this study. Tap water served as control. It was observed that soil pH decreased non-significantly in all the treatments with effluent application as compared to control. However, Nitrogen, Phosphorus and Potassium content of the soil increased significantly. Thus soil fertility improved in Integrated Nutrient Management System (I.N.M.S.) and agro-ecosystem.

**Keywords** : *Brassica juncea*, Meerut, Nitrogen, Phosphorus, Potassium

## INTRODUCTION

Rapid industrialization has left with us polluted air, green house gases, choked rivers, contaminated soil, depleted ground water, ozone layer, global warming, El-Nino and La-Nino effect, endangered wild life and exhausted natural resources. Industries generate millions liters of waste water or effluent which are hazards to environment and deteriorate the quality of surface and ground water too (Ali khan and Dhaka, 1989, Ali Khan, 1990) and had adverse effect on alpha ( $\alpha$ ), beta ( $\beta$ ), gamma ( $\gamma$ ), biodiversity and biogeographically mass of the world (Bhat and Bandhu, 1994). Water pollution has been intensified by industrial and agricultural insecticides, herbicides and fungicides, which have caused aquatic eutrophication in water bodies and “Chemical Time Bomb” (Stigliani *et al.*, 1988, Stigliani, 1993, Hackstra, 1991, Ali Khan and Ahmad, 1998). Gangol Sehkar Dugdh Utpadak Sangh Ltd., Partapur, Meerut is one of the 10<sup>th</sup> modern dairy industries (Pasteurization plant) of western U.P., which is located geographically 29° north & 77° 40' east and situated at 60 km north east of Delhi. Parag dairy generates 2000 to 3000 liters waste water after pasteurization of milk, cream, butter, milk cake, cheese powder etc. The dairy waste water contains caustic soda, amyl alcohol, nitric acid and sulphuric acid with high B.O.D. and acidic pH (6.5) but contains fat 20%, proteins 0.15% and 109 mg/l lactose (Rodionova *et al.*, 1989 and Fang, 1990). Now-a-days, use of effluent is beneficial in agriculture because of its value as a potential and a nutrient donor. Present investigation has aroused the interest because no efforts have been made to study on environmental pollution caused by Parag dairy Partapur, Meerut (U.P.). So, systematic disposal of dairy effluent acts as “Liquid Fertilizer” into cultivable land for agro-ecological effects on crop

and its impact on soil environment. Therefore, keeping above facts in view, present study was designed to evaluate the risk assessment of dairy effluent on environmental management and its effect on the soil.

## MATERIAL AND METHOD

The present investigation has been conducted to observe the physico-chemical characteristics of dairy effluent of Gangol Sehkar Dugdh Utpadak Sangh Limited (Parag) Partapur, Meerut and its effect on physico-chemical properties of the soil. The experiment was conducted in college campus with three cvs. of *Brassica juncea* L. Czern & Coss. viz., Pusa Bold, Pro-Agro 4001 and T-59. The effluent was collected at 10:00 a.m. for physico-chemical examination. The untreated samples were collected from the main drain of industry before entering into the Effluent Treatment Plant (E.T.P.). The treated samples were collected from outlet of the aeration tank, where biological treatment was given (Fig 1).

**Experimental Design:** Sterilized and dried seeds of three cultivars of *Brassica juncea* L. viz., Pusa Bold, Pro-Agro 4001 and T-59 were sown during winter season at the college agricultural research farm in sandy loam soil. The experiment was conducted in randomized block design (RBD) with three replications. Growth parameters were observed at 30, 45, 60, 75, 90 and 105 days after sowing (DAS).

**Soil Analysis:** The estimation of NPK (Nitrogen, Phosphorus and Potassium) content, pH and E.C. (Electrical conductivity) of fallow (Control) soil was done before applying the dairy effluent and thereafter it was analysed at harvest condition of the crop treated with effluent. Nitrogen was estimated by modified Kjeldahl's method, phosphorus by Vanado-molybdo-phosphoric yellow color method, potassium by Flame photometer and pH by pH meter.

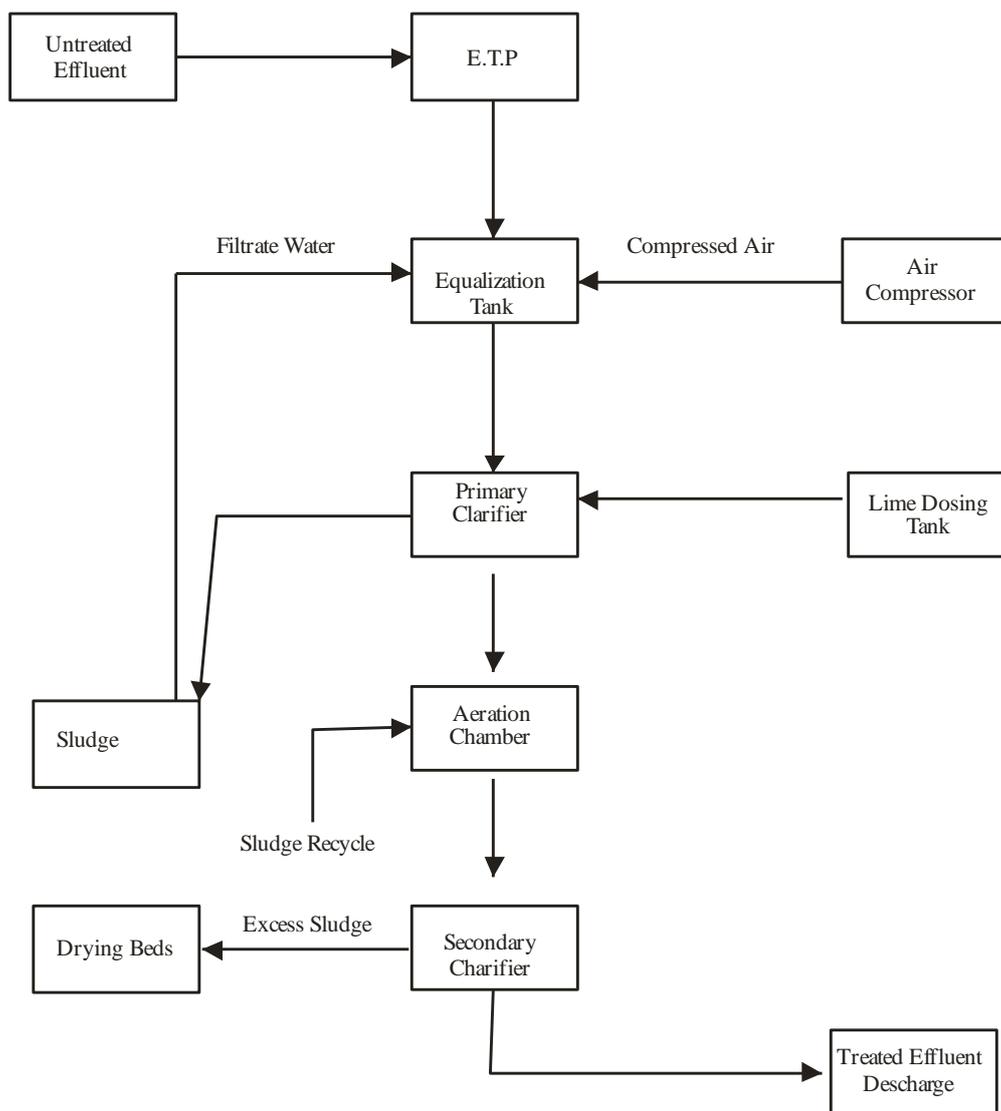


Fig 1. Flow chart of effluent treatment plant (E.T.P.).

## OBSERVATION

The soil represents most important natural media for plant growth and filtration system. They can effectively decompose organic compounds, recycling nutrients and protect the environment by removing substances from percolating water. Soil has immeasurable economic importance as a substratum. The soil pH, E.C. and N.P.K. have marked effect on the growth performance and environment. In the present study data on the physico-chemical characteristics of the soil without irrigation of dairy effluent (control) and after harvesting the crop have been studied. The soil samples were collected from each plot of different cvs. of *Brassica juncea* L. Parameters ranged from pH (7.92), E.C. (0.17 m mho/cm), N (0.40%), P<sub>2</sub>O<sub>5</sub> (10.30 kg/ha) and K<sub>2</sub>O (49.0 kg/ha) have been analysed in the fallow (control) soil (Fig 2).

## Pre-sowing irrigation effect of effluent on the soil

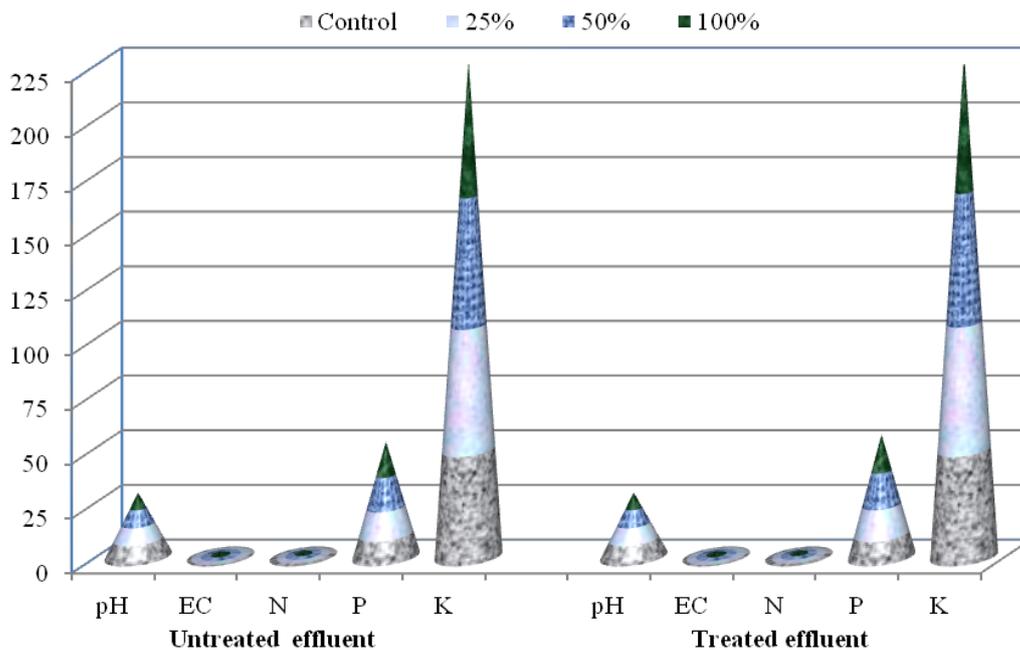
**pH:** It ranges from 7.11 (25%), 7.10 (50%) & 7.09 (100%) and 7.13 (25%), 7.12 (50%) & 7.10 (100%) in untreated and treated effluent, respectively (Fig 2).

**Electrical conductivity (E.C.) m mho/cm:** It was observed 0.40 (25%), 0.41 (50%) & 0.42 (100%) and 0.41 (25%), 0.43 (50%) & 0.44 (100%) in untreated and treated effluent, respectively.

**Nitrogen (kg/ha):** It was recorded 0.51 (25%), 0.52 (50%) & 0.54 (100%) and 0.52 (25%), 0.54 (50%) & 0.56 (100%) in untreated and treated effluent, respectively (Fig 2).

**Phosphorus (P<sub>2</sub>O<sub>5</sub>) kg/ha:** It was analysed 12.30 (25%), 14.60 (50%) & 15.30 (100%) and 13.40 (25%), 15.50 (50%) & 16.60 (100%) in untreated and treated effluent, respectively.

**Potassium (K<sub>2</sub>O) kg/ha:** It was found 57.0 (25%), 59.0 (50%) & 62.0 (100%) and 58.0 (25%), 60.0 (50%) & 63.0 (100%) in untreated and treated effluent, respectively (Fig 2).



**Fig 2. Pre-sowing irrigation effect of Parag dairy effluent on physico-chemical characteristics of the soil.**

**Soil analysis after harvesting the crop**

After harvesting the crop, following parameters were observed (Table 1).

**pH:** It was maximum in treated soil of *Brassica juncea* cv. P.A. 4001 and minimum in the soil of cv. Pusa Bold, while the effluent concentrations decreased the pH value due to acidic nature of dairy effluent in both untreated and treated treatments.

**Electrical conductivity (E.C.) m mho/cm:** It was observed that effluent concentrations gradually increased the value of E.C. in all cvs. However, minimum E.C. was found in cv. Pusa Bold in comparison to cvs. P.A. 4001 & T-59.

**Nitrogen, Phosphorus and Potassium (N.P.K.):** It has been recorded that N.P.K. of the soil increased significantly in all the cvs. as compared to control. However, it was maximum in cv. Pusa Bold.

**Table 1. Residual effect of Parag dairy effluent application on physico-chemical characteristics of the soil after harvest.**

Treatments	Cultivars	pH	EC (m mho/cm)	N (%)	Phosphorus P <sub>2</sub> O <sub>5</sub> (kg/ha)	Potassium K <sub>2</sub> O (kg/ha)
Control	Pusa Bold	7.93	0.15	0.40	10.25	48.00
	P.A. 4001	7.95	0.14	0.39	10.00	47.00
	T-59	7.94	0.14	0.38	9.60	46.00
<b>Untreated Effluent</b>						
25%	Pusa Bold	7.18	0.41	0.45	11.40	55.00
	P.A. 4001	7.26	0.28	0.44	10.60	53.00
	T-59	7.20	0.21	0.43	10.50	50.00
50%	Pusa Bold	7.17	0.42	0.48	12.60	57.00
	P.A. 4001	7.21	0.31	0.47	11.80	55.00
	T-59	7.18	0.23	0.45	11.70	52.00
100%	Pusa Bold	7.15	0.44	0.50	14.20	59.00
	P.A. 4001	7.20	0.34	0.49	13.20	57.00
	T-59	7.16	0.25	0.48	12.10	55.00
Mean	Pusa Bold	7.16	0.42	0.47	12.73	54.66
	P.A. 4001	7.22	0.31	0.46	11.86	55.00
	T-59	7.18	0.22	0.45	11.76	52.33
<b>Treated Effluent</b>						
25%	Pusa Bold	7.17	0.42	0.46	11.60	57.00
	P.A. 4001	7.27	0.29	0.45	10.80	55.00

	T-59	7.19	0.22	0.44	10.75	52.00
50%	Pusa Bold	7.16	0.43	0.49	12.90	58.00
	P.A. 4001	7.20	0.32	0.48	12.00	56.00
	T-59	7.18	0.25	0.47	11.95	53.00
100%	Pusa Bold	7.14	0.46	0.52	14.40	60.00
	P.A. 4001	7.16	0.36	0.51	13.50	58.00
	T-59	7.15	0.25	0.49	13.30	57.00
Mean	Pusa Bold	7.15	0.43	0.49	12.96	58.33
	P.A. 4001	7.21	0.32	0.48	12.10	56.33
	T-59	7.17	0.23	0.46	12.00	54.33

## DISCUSSION

The pH of the soil can have a dramatic effect on crop performance by influencing the solubility and availability of nutrient and non-nutrient elements. Thus, pH is an important factor in the characterization of the soil system. pH of the soil indicates the availability of mineral nutrients. Approximately, pH (6.5) of all mineral salts is sufficiently soluble to satisfy plant needs but increasing deviation to either direction certain nutrients become less soluble. Also nitrification of plant is compared below 6.0 and above 7.7 pH (Daubenmier, 1970). pH of the soil decreased with increasing the conc. of the effluent. It may be due to the acidic nature of the effluent. The industrial effluent generally affects the pH of the soil according to their own pH as has been clearly indicated by some of the studies (Ajmal *et al.*, 1984; Singh and Mishra, 1987).

High value of electrical conductivity of effluent indicates preponderance of dissolved salts which leads to the increased conductivity of effluent application. The differences in the values for investigated parameters between treated and control soil indicate the probable concentration of these parameters through the effluent. The differences in the values due to treatments are significant for almost all the plant parts of both types of soil raised plant, presence of nutrients responsible for increase into available plant nutrients (Igbounamba, 1972). Vandamme and Renterghem (1981) analysed sludge and dairy effluent from its composition and agriculture fertilizers ( $N_2$  and  $P_2O_5$ ). Davis and Burgoa (1995) revealed the runoff and leaching of crop nutrients from dairy effluent into soil tithed beds and discussed decreased  $NO_3^-$  leaching and it was suggested that as effluent application rate increased the large potassium concentration in the effluent exchanged with soil calcium and magnesium.

Goel and Mandavekar (1983) have discussed the higher absorption of nitrogen from the distillery effluent irrigated soil. Sachan and Menon (1976); Arceivala (1981) concluded that 10% diluted distillery waste can effectively used for irrigation of *Cyamopsis tetragonoloba*, which will increased the vigour of plants resulting in more yield and rich in protein. Application of phosphate fertilizer has led to

the accumulation of phosphorus in soil, resulting in depletion of phosphorus absorption/buffer capacity. Cadmium present as an impurity of phosphate fertilizer is applied in advently during fertilizer application, sewage sludge and contaminated manure (Stigliani, 1993). Potassium is one of the macro nutrient and acidly present in larger quantities than those of any other mineral nutrients derived from the soil with the exception of hydrogen and nitrogen. It was observed that soil pH decreased with increase dairy effluent conc. because dairy effluent is acidic. The available nitrogen, phosphate and potassium increased with increase in the conc. of dairy effluent added. Srikantha *et al.* (1998) have illustrated similar observations.

## CONCLUSION

Soil pH decreased non-significantly with effluent irrigation and gradually increased after harvesting the crop in comparison to fallow (control). Nitrogen (%), phosphorus ( $P_2O_5$  kg/ha) and potassium ( $K_2O$  kg/ha) contents of the soil increased significantly in effluent treated plots. However, it was observed that N.P.K. of the soil much increased after harvesting the crop, which improved soil fertility for integrated nutrient management system (I.N.M.S.) and agro-ecosystem.

## Recommendation

Research findings recommended that effluent should be properly treated before its disposal into available land then it could be used as "liquid manure", which is one the best practical method for the disposal of dairy effluents to eliminate pollution problems for "evergreen revolution". Therefore, effluent treatment plant (E.T.P.) should be installed in each pasteurization plant like distilleries to check water pollution so that water bodies like holy Ganga can be saved from deterioration. Further it will not only arrange marriage between environment and economy but would have also cascading effect on national economy to curb price inflation of fertilizer. Moreover, it will be a tool to handle "Chemical Time Bomb" in soil and sediment in world scenarios.

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