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EFFECT OF TREATED DAIRY EFFLUENT ON HEIGHT AND YIELD OF *ZEA MAYS* L.

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ABSTRACT
The present study was carried out to investigate the effect of treated dairy effluent on the height and fresh weight of *Zea mays* L. variety RCM 1-3. The plants were irrigated with different concentration of treated dairy effluent (100, 50 and 10%) and tap water using as a control. The height of the plants was measured at 15 days interval and yield was taken after harvest. The results showed that height and yield of maize increased significantly with 100% treated dairy effluent as compared to 50%, 10% treated dairy effluent and control. Thus, it may be concluded that treated dairy effluent may be used for irrigation purposes.
Keywords: *Zea mays*, dairy effluent, height, yield.

INTRODUCTION

Treated wastewater is being used in many countries throughout the world as a reliable source of water which can fulfill the gap between supply and demand in water sector[1]. Majority of industries are water based and a considerable volume of waste water is discharged to the environment either treated or inadequately treated leading to the problem of surface and ground water pollution. Advancements in the effectiveness and reliability of wastewater treatment technologies have improved the capacity to produce recycled water that can serve as an alternative water source in addition in meeting water quality protection and abatement requirements[2].The benefits from the use of treated wastewater are manifold especially to the countries that are facing chronic shortage of water supply and where the economy is mostly agri-based. However, at the same time the health and environmental risk pertaining to the reuse of treated wastewater especially in agriculture cannot be ignored.

Therefore, reuses of treated wastewater requires effective treatment and to protect public health and the environment at an affordable cost.[3-6] The dairy industry generates waste composed of milk residues and cleaning products. This effluent may be dumped directly on to agricultural land, so that soils and crops act as purifying agents[7], or it may be subjected to biological or physicochemical treatments. The latter methods produce a treated aqueous phase, which can be discharged into rivers, and a sludge that may undergo one of many secondary treatments and be disposed of in a variety of ways. These dairy sludges are relatively low in heavy metals, organic contaminants and other constituents harmful to human and animal health, when compared to municipal sludges.[8]

The economy of Meghalaya is basically agrarian as it is rural based with Agriculture playing a predominant role in the state's economy. The second most important foodgrains crop in the state is Maize which covered an area of about 16.87 thousand hectares with a total production of about 24.00 thousand M.T during 2004-05. The main factor which is responsible for low crop yield is the lesser availability of irrigation water.[9] Application of waste products to agricultural land is an efficient method of recycling them, while at the same time improving the productive capacity of soils.[10-11] However, further studies are needed to investigate the fertilizing properties of these residues in comparison with inorganic fertilizers. It is also important that their use as fertilizers is carefully planned to take advantage of their good qualities while minimising the potential environmental risks. Hence, the present study was conducted to access the impact of dairy effluents on height and yield of maize plant and its effect on soil.

EXPERIMENTAL

Field experiment was carried out between May 2009 and August 2009 at Central dairy, Mawiong located 8kms from shillong. Total rainfall between May and August was about 381.5mm in May and 504.4m in August. Average monthly temperature ranged from28.1 °C in August to a maximum of 27.9°C in August.

Table-1: Physico-chemical characteristics of dairy effluent.

Parameters	Treated effluent	Control
pH	7.1±0.01[a]	6.9±0.01[a]
Electrical conductivity(μScm^{-1})	225±0.04[a]	71±0.04[b]
Turbidity (NTU)	97.67±0.02[a]	1.1±0.03[b]
Total Suspended Solids (mgL^{-1})	45±0.05[a]	20±0.04[b]
Total Dissolved Solids (mgL^{-1})	162±0.02[a]	70±0.02[b]
Potassium (mgL^{-1})	1.73±0.004[a]	3.6±0.003[b]
Chloride (mgL^{-1})	24±0.002[a]	13±0.001[b]
Total Hardness (mgL^{-1})	29.33±0.03[a]	20±0.02[b]
Nitrate (mgL^{-1})	1.57±1.002[a]	1±0.002[a]
Phosphate (mgL^{-1})	0.8±0.003[b]	ND
Dissolved Oxygen (mgL^{-1})	5.98±0.001[a]	6.8±0.003[b]
Biochemical Oxygen Demand (mgL^{-1})	138±0.02[a]	3.5±0.001[b]
Chemical Oxygen Demand (mgL^{-1})	258±0.04[a]	11.08±0.01[b]
Oil & grease (mgL^{-1})	36±0.03[a]	0.02±0.03[b]

Mean values followed by the same letter in a row are not significantly different according to Tukey test ($p<0.05$)
ND: Not Detected

Experimental Design

The experiment was conducted out in a randomized complete block design with five replications in a 200sq meter area with subplots of 2m x 2m. Maize variety RCM 1-3 was used. The maize was established at 2seeds / hole at 30 cm spacing on rows 80 cm apart. The plots were weeded manually, at 3 and 6 weeks after planting (WAP). The field was irrigated with 6litres of dairy effluent on each subplot.

Table-2: Macronutrients and organic content of soil

Parameters	T-100	T-50	T-10	Control
N(ppm)	271.6±2.8[a]	256.4±0.01[b]	232.4±8.4[c]	156.8±33.6[d]
P(ppm)	0.691±0.001[a]	0.614±0.0005[b]	0.214±0.001[c]	0.261+0.006[d]
K(ppm)	0.7±0.005[b]	0.73±0.01[b]	0.83±0.01[a]	0.83+0.01[a]
Organic Carbon (%)	13.75±0.05[a]	13.65±0.05[a]	13.4±0.2[a]	14.4±0.2[b]

Mean values followed by the same letter in a row are not significantly different according to Tukey test ($p<0.05$)

Data Collection

Data were taken from 5 plants per subplot to measure the height of plant of 15 days interval and the cobs from each subplot were taken as the yield of maize.

Statistical test:

The data in this study were analyzed using MS Excel and Origin 7, and all the values are presented as the mean± SE. The probability levels used for statistical significance were $P < 0.05$. Standard errors of means were calculated and analysis of variance (ANOVA) was carried out and means were separated by Tukey test.

RESULTS AND DISCUSSION

The physico-chemical characteristic of dairy effluent was presented in Table 1 and macronutrients (Table-2) in the soil were found to be 120.88 ppm for nitrogen, 0.02ppm for phosphorus and 4.4 ppm for

potassium. The height of maize (Table-3) after 90 days of harvest was found to be highest in T-100 (243 cm) and then by T-50 and T-10.The yield (Table-4) after harvest was highest when applied with T-100.

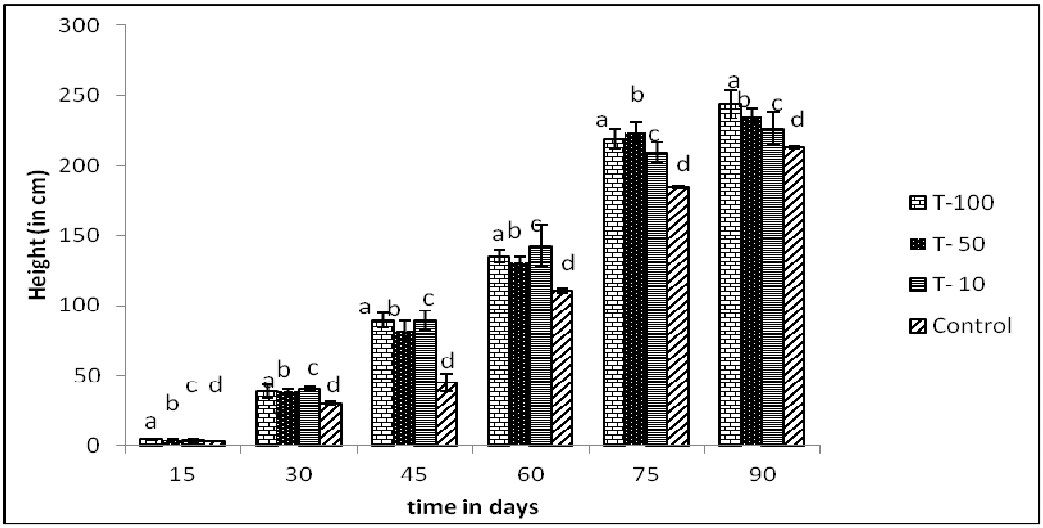

Fig.-1: Height (cm) of maize plants at different time intervals

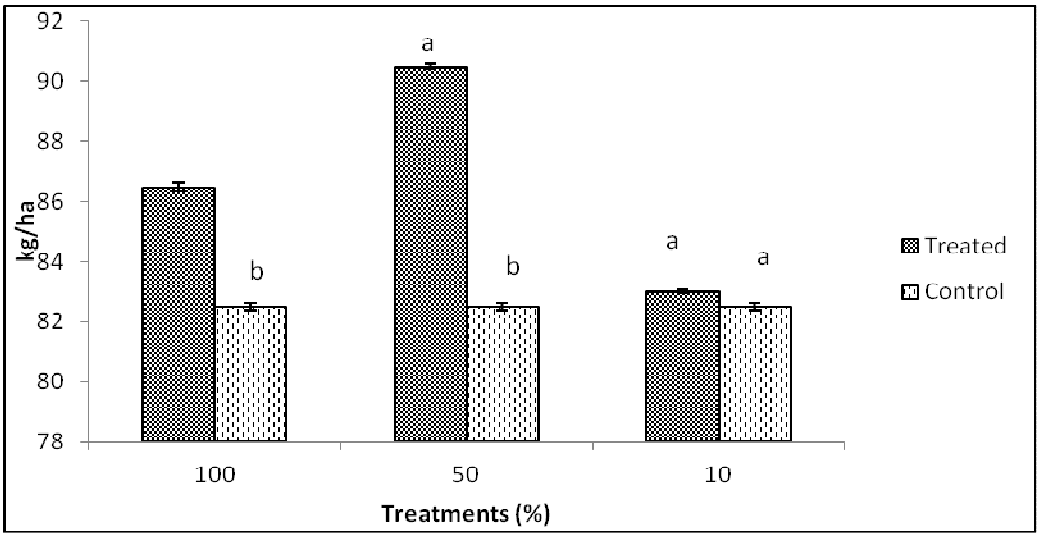

Fig.-2: Yield (kg/ha) of maize plants after harvest

Table-3: Height of maize crops at 15 days intervals

Treatment	Height (in days)					
	15	30	45	60	75	90
T-100	4.33±0.33[a]	38.65±4.60[a]	89.52±5.18[a]	135.41±4.64[a]	219.14±6.95[a]	243.93±10.10[a]
T- 50	4±0.58[b]	38.54±1.8[b]	82.18±6.99[b]	130.13±4.89[b]	223.5±7.09[b]	235.51±5.09[b]
T- 10	3.33±0.88[c]	40.29±1.7[c]	89.56±6.32[c]	142.37±15.22[c]	209.26±7.32[c]	226.47±12.07[c]
Control	3±0.1[d]	30.29±1.7[d]	45±6.31[d]	110.23±1.22[d]	185±1.03[d]	213±1.02[d]

Mean values followed by the same letter are not significantly different according to Tukey test (p<0.05).

The physico-chemical characteristic of dairy effluent was presented in Table 1. The analysis of dairy effluent used revealed that it is white in colour, alkaline, turbid and have an unpleasant smell. It consists of high amount of oxygen demanding waste, total suspended and dissolved solids. Oil and grease was found to be above the permissible limit. The other parameters (nitrate, phosphate, total hardness and chloride) are at moderate level.

Nitrogen, phosphorus and potassium concentration increased by irrigation with wastewater rather than control (tap water). The importance of wastewater to supply these elements in the soil results from other studies had reported that total soil nitrogen increased under the influence of urban wastewater or wastewater sludge irrigation; and increase in potassium and phosphorus in the soil as a result of wastewater application[12-13]. The growth of various crops has been reported to be influenced by different types of effluents. Treated effluent of chemical industry was found to be effective in promoting germination, growth, chlorophyll and protein content of *Mungo*[14]. Although corn breeders have reported a positive correlation between plant height and yield, there are experimental results where no or negative correlation has been observed[15-17].

Table-4: Yield of maize plant after harvest (kg/ha)

Treatments (%)	100	50	10
Treated	86.5 ± 0.15^{a}	90.5 ± 0.10^{b}	83.0 ± 0.06^{c}
Control	82.5 ± 0.12^{b}	82.5 ± 0.12^{b}	82.5 ± 0.12^{a}

Mean values followed by the same letter are not significantly different according to the Tukey test ($p<0.05$)

The present study corroborate with the findings of[18-19] who found increased yield of maize irrigated with treated wastewater. Generally, it is suggested that the increase in maize yield and height resulted from the following items: (i) increase of treated wastewater application rate causing higher nutrient inputs[20], (ii) higher uptake and accumulation of nutrients, mainly of N and P[21] and (iii) occurrence of macro and micronutrients in the effluent which can neutralize the undesirable effect of high Na concentrations in treated wastewater[22].

CONCLUSION

The treated wastewater generated through the Dairy effluent was shown to be as effective as inorganic fertilizer and provides good growth and yield of maize crop. The most important advantage in the use of treated wastewater is that it can avoid environmental problems of discarding it into adjacent water bodies. Thus considerable quantities of fresh water can be saved for human consumption. Also treated dairy wastewater is sufficiently rich in NPK nutrients; therefore, it can be safely used as an alternative source of fertilizer in order to have a profitable yield of maize crop.

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