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Effects of Labana Rice Mill Effluent on the Germination and Growth Performance of *Lycopersicum esculentum* L

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Abstract
This study investigated the effects of labana mill effluent on the germination and growth performances of the *Lycopersicum esculentum* L. at different effluent concentrations (0%, 25%, 50%, 70% & 100%) in randomized blocks. Physical and chemical parameters were determined using atomic absorption spectroscopy. There was a significant ($P<0.05$) inhibition of several organs measured at different concentrations of effluent compared to control. Therefore, Labana effluent may be reused for the cultivation of *Lycopersicum esculentum* L. treated as 70% for better yields. However, investigation of the anatomical effects of this effluent should properly conduct on *Lycopersicum esculentum* L. cultivated with wastewater.

Keywords: Labana Mill Effluent, *Lycopersicum esculentum* L., Physiochemical Parameters

1. Introduction
Agricultural activities near industrial zones, where effluent is directly discharge on the soil or cultivar plant especially vegetables pose serious risks to the environment and human health. The increase in human population growth, food production and water scarcity are major problems in African countries. There is high demand of leafy vegetables or fruits of vegetables throughout the year all over the worldwide due to health impact. For this reason, many farmers rely on wastewater especially industrial wastewater, to grow vegetables during the dry season to meet market demand throughout the year [1, 2]. Industrial wastewater has been used for irrigation of crops and vegetables in both developing and developed countries, but this not a new idea today [3, 4]. [5] reported that when properly used by farmers, wastewater contains various nutrients required for cultivation.
Lycopersicum esculentum L.(Tomato) are one of the major vegetables consumed in most prepared foods worldwide. Nutritionally, it contains moisture (93%), ash (0.22%), protein (0.11%), fibre (0.15%), lipid (0.10%) and carbohydrate (5%) [6]. Wastewater contains non-essential metals that are harmful to agricultural land, plants and microbes, especially when the concentrations exceed certain required limits. Higher salinity in wastewater has been reported to alter the physiological, viability and growth performance of crops [7]. Plant uptake of heavy metals such as K, Mg, S, P, Ca, Fe, Mn, Zn and Cu affects the root to tip movement of specific minerals [8, 9, 10], studied the effects of wastewater from the Razi petrochemical complex on two wheat cultivars Chamran and Behrang. [11] reported that the impact wastewater on potato plant positively. [12] showed that lead significantly reduced wheat germination, growth, physiological, biochemical and yield characteristics. Wastewater adds organic and inorganic substance on the soil [13]. The impact of heavy metals is an area of research and innovation especially in the agricultural sector. With continued human activity on Earth, reused of industrial waste to benefit people is a priority. This research aimed to investigate the effect of industrial waste water of Labana Rice Mill on the germination and growth performance of tomato.

2. Materials and methods
Study Area
Labana rice mill is an integrated rice mill located in Sani Abacha bye-pass, Harasawa within Birnin Kebbi. It has latitude of 12.451983 and longitude 4.232186. Labana rice mill was established in 2012 and commenced production 2014 with two independent plants that have the capacity to produce 400MT/DAY [14].

Collection of Industrial Waste Water and Tomato Seed
Labana rice mill effluents were collected early morning from the factory drain using clean plastic jerycan. Tomato seeds were

purchased from the Aleiro market in a sterile polythene bag and professionally certified by Expert. All the samples were taken to the Botany laboratory, Department of Plant Science and Biotechnology, Kebbi State University of Science and Technology Aleiro for further research.

Preparation of Soil samples and Effluent

The loamy soils used in this study were obtained within the Botanical Garden of the Kebbi State University of Science and Technology Aleiro, Aleiro Local Government Kebbi State, Nigeria. 15 pre-labelled (according to the treatment concentrations used in watering them), perforated polythene bags were filled with the soil and then weighed on the electronic digital weighing balance (model: FEJ 600). Different concentrations of labana influent were used during the experiments for irrigation as; 0% control (100ml tap water), 25% concentration (25ml effluent + 75ml tap water), 50% concentration (50ml effluent + 50ml tap water), 70% concentration (70ml effluent + 30ml tap water) and 100% concentration (100ml effluent).

Germination Studies

Fifteen (15) Petri dishes half-filled with loamy soil were used and then 15 seeds of tomato were sowing in each petri-dish which was labeled according water treatment concentration levels (0%, 25%, 50%, 75% and 100%) throughout the experiment. Each Petri dish was observed after every 12hours for seedling emergence (germination). The germination rate was calculated using the following formula;

$$\text{Germination (\%)} = \frac{\text{total no. of germinated seed}}{\text{total no. of seed sown}} \times 100$$

Transplanting

The seedlings were transplanted at Botanical Garden of the Department of Plant Science and Biotechnology, KSUSTA in the evening time to avoid effects of transpiration on seedlings three weeks after germination, seedlings were transplanted into 15 polythene bags each containing enriched soil. The plants were watered with tap water at intervals of two days to stabilize the seedlings before applying wastewater. After that, effluents concentrations of 0%, 20%, 40%, 60%, 80% and 100% respectively were applied to the seedlings respectively.

Field Experiment

After germination, completely randomized experiments were designed with five irrigated treatments in three replicates each. Fifteen (15) perforated polythene bags were filled with loamy soil, labeled accordance to different treatment concentrations and watered morning and evening during the 90 days of tested period. Weeding was done after every three days in other to prevent seedlings-weed competition for the nutrients and the physicochemical properties contained within the treatments [15].

Experimental Parameters Measured

The parameters considered in this study were the number of seed/seeds germinated after every 12hours (the protrusion of redicle through the seed coat), stem length, leaves width, leaves length after maturity (90days) were measured using measuring tap line and number of fruit and leaves per plant produced were account using stick.

Determination of Chemical Properties of Labana Effluent

The pH of the effluent samples was measured using a Jenway pH mobile 3015 pH meter. Other parameters such as nitrogen, phosphorus, copper, K, Ca and Mg were determined according to the method of AOAC (2002) while biological oxygen demand (BOD). Heavy metals presences and concentrations such as Fe, Cr, Pb, Zn, Cd and Cu were determined using Atomic Absorption Spectroscopy (AAS Model 220) [14]. Data were analyzed using (ANOVA) and means were separated using Duncan's Multiple Range Test (DMRT) at $p < 0.05$ level of significance, through Statistical Package for Social Sciences (SPSS) version 20.

3. Results and discussion

Table 1: Showing Physical and Chemical Parameters

Parameters	Values Obtained
pH	6.643±0.005
Temp	34.700±0.173
DO	36.130±0.017
BOD	0.6333±0.057
Ca	189.56±0.565
Mg	129.45±1.172
Na	230.15±0.766
SO	320.21±1.241
Cl	229.94±0.057
HCO	690.45±5.871
CO	174.82±2.338
NH	118.86±3.326
NO	357.25±112.38
TDS	246.67±6.429
Cu	BDL
Zn	0.2000±0.010
Fe	0.1400±0.010
Pb	0.6200±0.017
Cd	0.1100±0.010
Cr	0.03333±0.057

Values obtained were expressed as mean ± SD. BDL= Below Detected Level.

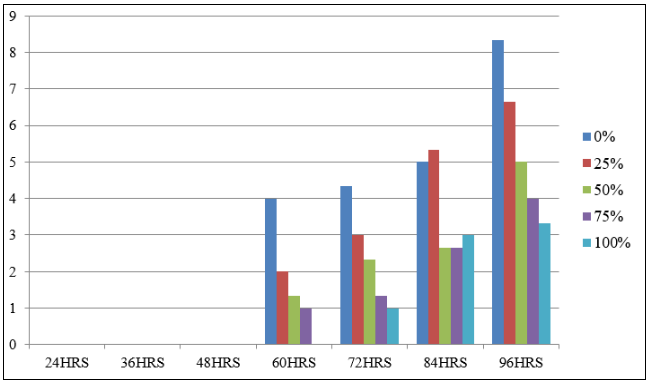

Fig 1: Showing germination studies of *Lycopersicum esculentum* L.

Table 2: Growth Performance of *Lycopersicum esculentum* L.at Varied Concentrations

			Organs		
Concentration (%)	**No. of Leaves**	**Leaves length**	**Leave width**	**Stem length**	**No. of Fruit**
0	12.333±2.51	4.500±0.50	2.400±0.17	20.567±2.61	6.333±1.52
25	19.333±1.15	5.900±0.96	2.900±0.36	20.400±0.81	8.333±1.15
50	27.667±2.51	8.967±0.55	3.467±0.15	29.300±4.71	21.667±3.78
75	37.333±7.50	4.467±0.98	2.767±0.83	38.400±2.55	21.000±4.00
100	8.667±1.15	2.867±1.02	3.067±0.20	23.700±10.54	6.333±4.04

Values obtained were expressed as mean ± SD

These findings reveal that, the chemical components of Labana industrial effluent analyzed had higher values than the specific limited set by [16] as water used for cultivation. [17] observed various parameters of effluents from the Labana mill with DO and BOD exceeding WHO permissible limits. The increase values in some of the parameters obtained from the wastewater maybe as result of a high level of pollutants especially chemicals used during the mill of rice lead to the undesirable water use for irrigation purposes. This is analogy to the study of [18].The pH value detected in the presence study is acidic (Table 1). According to the statement of [19] pH of 7-8 is suitable for growing crops. In a related development [20] reported that the pH industrial wastewater in Bangladesh was found between 8.9 - 11. These found higher than our results. Normal levels physical and chemical parameters in water or soil support plant cultivar growth but exceeding recommended levels are detrimental [21]. The values of sheavy metal concentrations obtained in this study do not buttress those reported of [22] which found the value of 6.625 in Cr, 1.75 Pb, 2.313 Cu and 1.813 Zn. On the other hand, [10] reported lower values of Ca, Na, NO_3^- and Co with the highest NH4, Mg and SO_3^{2-} from Razi petrochemical complex wastewater compared to the current findings. [17] also detected heavy metals in labana mill effluent.

In this study, the results obtained for seed germination show that a low concentration of effluent promotes Tomato seed germination compared to high concentration of effluent, which has been found to be harmful. The reduced germination of seeds irrigated with 100% concentration of labana effluent may be due to pH and other observed parameters. This result is inconsistent with that of [20] found no mustard seed germination in 100% of the textile and dyeing wastewaters. The results of previous reports [18] correlates with the observations recorded in this study. Some irrigation done with wastewater have significant impacts not only on plants and humans, but also on ecosystem as whole, heavy metals in particular are known to be absorbed by plants [23].

Table (2), the rate of growth and length of tomato organs measured depended on the effluent concentration, with the lowest average values observed at 100% concentration and the highest growth observed at 70% effluent treatment. Similar results were reported by [24] who pointed reduction in shoots and roots of *Zea mays* at 100% effluent concentration. Moreover, the present results are consistent with the findings of [25] who obtained significant increase in tomato plants cultivated with municipal wastewater. Water scarcity and poverty have increased the use of industrial wastewater for irrigation without being considered a health hazard to human and plants. Leaf discoloration occurs during the experiments likely due to exposure of certain parameters detected in the wastewater.

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