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Impact of Distillery Effluent on germination and seedling growth of *Pisum sativum* L.

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Abstract:

Experimental effects of post-treated effluent from the outlet of anaerobic treatment plant (treated effluent), discharged from a distillery unit were studied in *Pisum sativum.* The physico-chemical characteristics of the effluent indicate that it is alkaline and rich in chlorides and total dissolved solids (TDS). Effluent colour is dark brown and has a pungent smell. Distillery effluent did not show any inhibitory effect on seed germination, vigor index, root length, shoot length and dry weight at a lower concentration (25%).

Keywords: Distillery effluent; germination percent; vigor index; plant biomass

1.0 Introduction:

Human evolution has led to immense scientific and technological progress. Global development, however, raises new challenges, especially in the field of environmental protection and conservation (Bennett et al., 2003). Nearly every government around the world advocates for an environment free from harmful contamination for their citizens. However, the demand for a country's economic, agricultural and industrial development outweighs the demand for a safe, pure, and natural environment. Ironically, it is the economic, agricultural and industrial developments that are often linked to polluting the environment (Ikhuoria and Okieimen, 2000). The problem of environmental pollution on account of industrial growth in practical terms is the problem of disposal of industrial waste, whether solid, liquid or gaseous. All three types of wastes have the potential of polluting water. Polluted water, in addition to other directly affects soil not only in industrial areas but also in agricultural fields, as well as the beds of rivers, creating secondary sources of pollution (Kisku *et al,* 2000; Barman *et al,* 2000). Use of industrial effluent and sewage sludge on agricultural land has become a common practice in India as a result of which the toxic metals present in the effluent can be transferred and concentrated into plant tissues from the soil. In addition to providing large quantities of water, some effluents contain considerable amount of essential nutrients which may prove beneficial for plants. Although some work has been done on the performance of various crops irrigated with the effluent discharged from various sources (Vogel *et al***,** 2005**;** Swaminathan *et al*, 1989**;** Gautham and Bishoni, 1992**;** Muthusamy and Jayabalan, 2001). Present study was conducted to find out the effect of distillery effluent on germination and seedling growth of *Pisum sativm*.

2.0 Materials and Methods:

An effluent sample was collected during the month of October (peak hours) from outlets of (Distillery effluent) Mohan Meakins Distillery Ltd. situated at Daliganj, Lucknow district, Uttar Pradesh. Effluent sample was collected in well cleaned plastic bottle. After filtering, pH and Electrical conductivity (EC) of the sample were immediately measured in the laboratory and afterwards the samples were stored at 4^0C for physicochemical analysis. The methodology of APHA (2005) was followed. The seeds of *Pisum sativum* were surface sterilized prior to germination studies. Different concentrations of effluent (10, 25, 50, 75 & 100%) were prepared and distilled water was used as control. Each treatment including control was performed in triplicate and in every petridish 10 seeds were used. The number of seeds germinated in each treatment was recorded and the germination percentage and vigor index (Abdulbaki & Anderson, 1973) was calculated. Growth of the root and shoot length were measured with the help of meter scale. For biomass of root, shoot and leaves, samples were oven-dried separately at 80^0C for 48 hours and dry weight (gm) was determined on a digital balance.

3. Result and Discussion:

The basic tool for the evaluation of complex industrial waste is the physico-chemical and toxicological bioassay (Webner *et. al.* 1989). The physico-chemical analysis of the distillery effluent is given in **Table-1**. The Distillery Effluent was red brown in colour with unpleasant odour of Indol, Sketol and other sulphur compounds (Santiago, *et al.,* 2006). The color of effluent has its origin from raw sugar and the colorant have been reported as being caused by thermal degradation products of reducing sugars and amino compounds, the so called Melanoidins & Polyphenolic compounds or complexes of polyphenolic compounds. The average pH value of the distillery effluent was 8.5. According to previous studies pH plays a significant role in toxicity **(**Martin, 1987, Truman *et. al.*, 1986). The range of dissolved oxygen in the distillery effluent was nil, meanwhile the recommended BIS range is 4-6. The absence of D.O. was possibly due to high organic load. The average value of total solid in distillery effluent is 220.36 far from the BIS recommended range that is 100.

The organic and inorganic salts also result in high electrical conductivity. The important parameters used for evaluation of performances of effluent quality for its use in irrigation and discharge into water bodies are TDS, TSS, TS because solids might clog the pore-space between two soil particles and can disturb the distribution of water (Suriyanarayanan *et. al.,* 2005). The higher values of BOD and COD may due to presence high organic load and chemical substances such as resin, caustic soda. The value of COD may vary depending on the composition of organic non-sugar proteins and hemi-cellulose gums in the spent wash produced during processing (Thanpi, 2000). Hardness of water is usually due to the dissolved chlorides, sulphates, carbonates and bicarbonates of calcium and magnesium ions. Being plant originated, the distillery effluent also contains considerable amounts of plant nutrients and organic matter, sulphide and chloride are also present in appreciable amounts.

From Fig-1, it is evident that there was variation in germination percentage. The higher EC alter the chelating properties of receiving water systems, which create conditions for free metal availability to flora and fauna (Nanda *et al*, 1999). Inhibition of seed germination may be due to high levels of dissolved solids which enrich the salinity and conductivity of the absorbed solute by seed before germination (Gautham and Bishoni, 1992). Murkumar and Chauan (1987) have reported that the higher concentration of effluent decrease enzyme dehydrogenase activity that is considered as one of the biochemical change which might have disrupted germination and seedling growth.

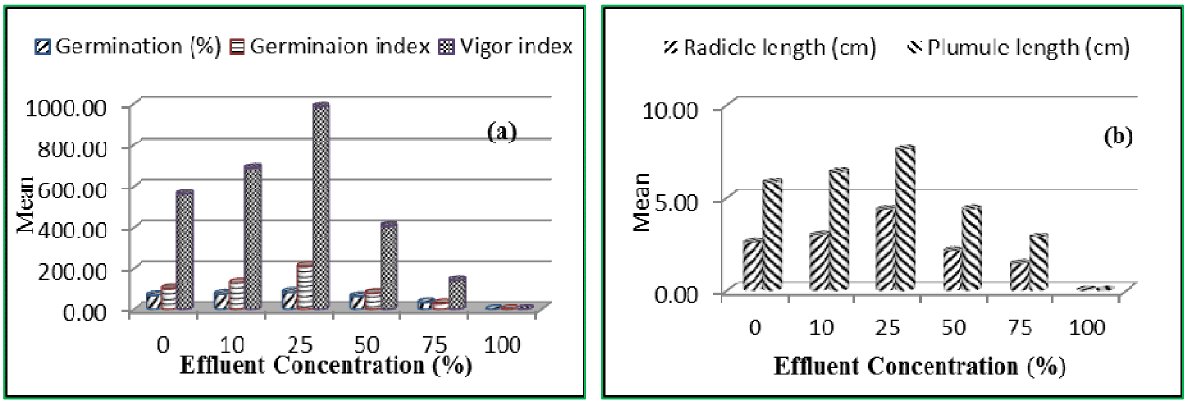

Fig.1 (a) Germination percent, Germination Index and Vigor Index **(b)** Radicle and plumule length

Table 1: Physico-Chemical Characteristics of Distillery Effluent (Mean ± SD)

Parameters	**Mean ± SD**
Colour	Dark Brown
Odour	Pungent
pH	8.25 ± 0.05
EC (dSm^{-1})	7.15 ± 0.08
TS	3263.29 ± 1.82
TDS	3029.55 ± 1.68
TSS	233.74 ± 2.21
DO	Nil
BOD	5980.83 ± 1.97
COD	21999.47 ± 1.99
Alkalinity	1441.40 ± 1.91
Total Hardness	475.77 ± 1.74
Chloride	748.07 ± 2.28
Sulphide	16.89 ± 0.07
Metals ($\mu g\ ml^{-1}$):	
Iron	1017.37 ± 0.61
Manganese	414.88 ± 1.53
Copper	153.29 ± 2.52
Zinc	101.85 ± 3.05

The germination percentage diminishes gradually with elevation in concentration. The germination percent in *P. sativum* was 82.22% at 25 percent concentration. The vigor index of tested vegetation also varies with respect to different concentration of effluent. The maximum vigor index (984.31) was at 25% concentration. Regarding the effect of higher osmotic pressure on seed germination Rodger *et al.* (1957) reported that higher osmotic pressure causes retardation of germination. The cause of higher osmotic pressure is the higher mineral salt content of the effluent seen in the form of higher electrical conductivity. Same type of finding has been reported by Ramana, *et al.* (2002), Pandey and Sony (1994). The root and shoot length of the seedlings indicate that effluent at upto 25% concentration had a marked promoting effect on the overall growth of the seedlings. At 25% of effluent concentration, increase in root and shoot length was observed as compared to control whereas at 75% of effluent concentration decrease in length of root and shoot was recorded.

4. Conclusions:

This is an important work as it suggested that nutrients available in 25% distillery effluent may be used as a suitable liquid fertilizer. It will reduce the quantity of water required for irrigation and help in water conservation and provide nutrients to the field and plants. Proper care should be taken in disposal of distillery effluent to avoid soil pollution.

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