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Original Research Paper

Impact of Seafood Processing Factory Effluent on Seed Germination and Early Seedling Growth of *Vigna sinensis* L. and *Oryza sativa* L.

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ABSTRACT

The present study was undertaken to determine the effect of a seafood processing factory effluent on seed germination, early seedling growth and chlorophyll content of *Vigna sinensis* L. and *Oryza sativa* L. The effluent was collected from a seafood processing factory at Aroor in Alleppey district, Kerala. The physico-chemical parameters pH, DO, BOD, COD, TDS, hardness and chlorides were analysed. The seeds of *Vigna sinensis* and *Oryza sativa* were grown in the varying dilutions of the effluent. The analysis of rate of germination, early growth of seedlings and chlorophyll content showed a decrease with higher concentration of the effluent. It could be suggested that the effluents could be safely released into the water bodies or for irrigational purpose only after sufficient dilution.

INTRODUCTION

Quality criterion of water is assessed on the basis of the total dissolved matter present in it. The indiscriminate disposal of the industrial effluents into the water bodies can bring about a change in the physico-chemical nature of water. The sewage and industrial effluents are discharged indiscriminately into the water bodies. This is a major cause of pollution of rivers into which they are discharged. Several reports are available of the phytotoxic effects resulting from irrigation of crops with effluents from different types of industries (Pandey et al. 2008, Ramachandra et al. 2008). In the present study a preliminary attempt has been made to evaluate the pollution potential of the effluents from seafood processing factory (Abad Exports Pvt. Ltd; Aroor). The objective of the present work is to analyse the impact of the effluent at different concentrations on the seed germination, early seedling growth and chlorophyll content of *Vigna sinensis* and *Oryza sativa.*

MATERIALS AND METHODS

Collection of the effluent sample was done in February 2013 between 11 a.m. and 12 p.m. from the main outlet of the factory. Effluents were collected in well cleaned polythene bottles which were rinsed with distilled water. The colour, odour and pH were measured in the laboratory and the samples were stored at 4°C for physico-chemical analysis (APHA 2005).

Twenty healthy seeds of *Vigna sinensis* L. and *Oryza sativa* L. used for the study were surface sterilized with 0.1% mercuric chloride solution for 2 minutes and washed with double distilled water to eliminate contamination of the seed coat (Singh et al. 2006).

The effluent was suitably diluted with distilled water to give 10%, 20%, 50%, 75% and 100% concentrations. The distilled water served as control. Triplicates were maintained in each experiment. The number of seeds germinated, length of the radicle, plumule and chlorophyll content were recorded at different periods of growth. The total chlorophyll content was estimated spectrophotometrically (Arnon 1949).

RESULTS AND DISCUSSION

The effluent from the seafood processing factory was analysed for parameters like pH, DO, BOD, COD, TDS, hardness and chlorides. The results are given in Table 1, which showed high values for pH, BOD, COD, TDS, hardness and chlorides with low DO (0.45 mg/L). It has been observed that on the second day of treatment, the rate of germination was highest in 10% concentration of the effluent (83%) followed by 25% and 50% concentration. The 75% and 100% concentration effluent did not show any germination on the second day. In both *Vigna sinensis* and *Oryza sativa* the rate of germination was found to increase progressively with increased dilutions of the effluent (Figs. 1 & 2). This delay in seed germination in both the species could be caused by the decrease in water uptake due to high levels of solute present in the effluent (Mishra & Bera 1996). High dissolved solids in the effluent will disturb the osmotic relations of the seeds and water, thus reducing the amount of absorbed water and retarding seed germination by enhancing the acidity and

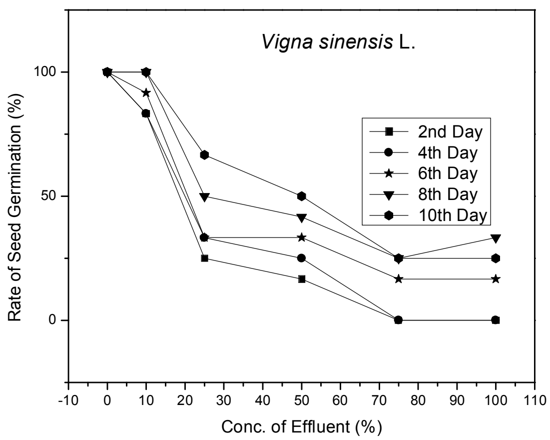

Fig. 1: Effect of effluent on the rate of seed germination in *Vigna sinensis.*

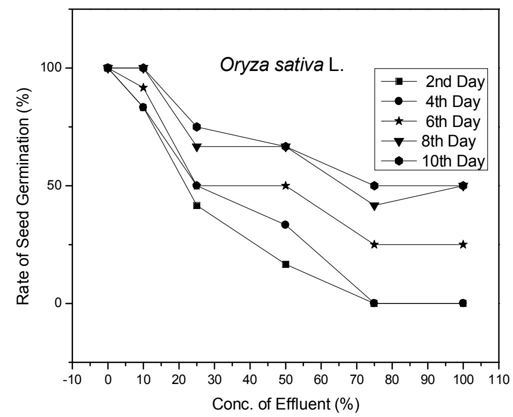

Fig.2: Effect of effluent concentration on rate of seed germination in *Oryza sativa* .

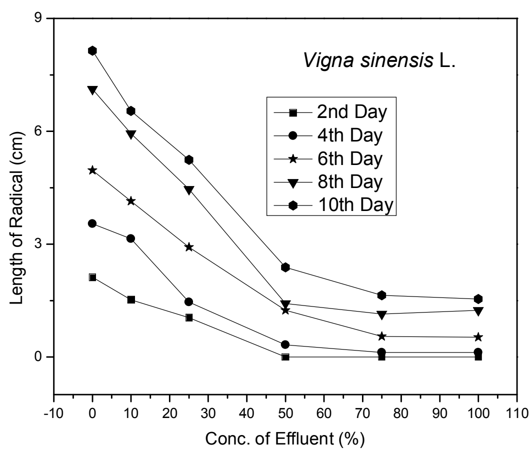

Fig. 3: Effect of effluent on the length of radicle in *Vigna sinenis.*

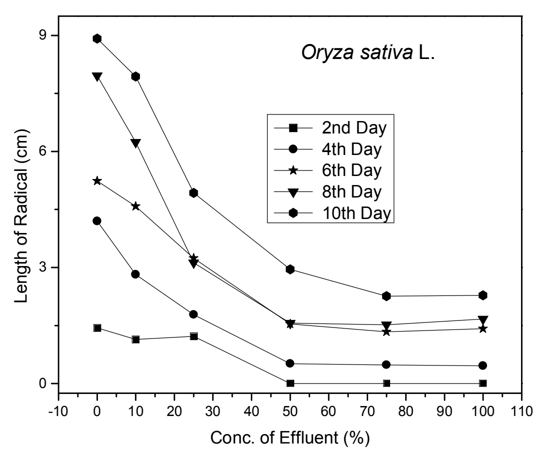

Fig.4: Effect of effluent on the length of radicle in *Oryza sativa.*

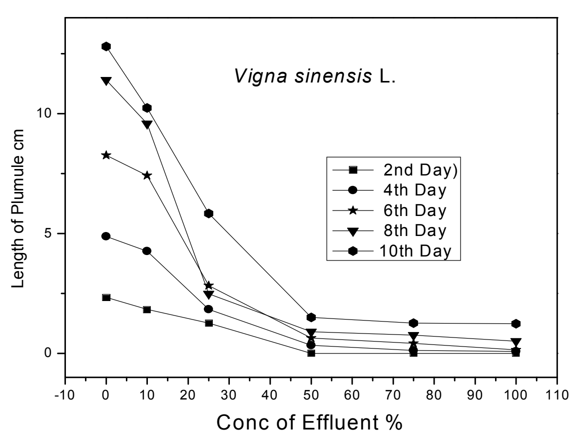

Fig. 5: Effect of effluent on length of plumule in *Vigna sinensis*.

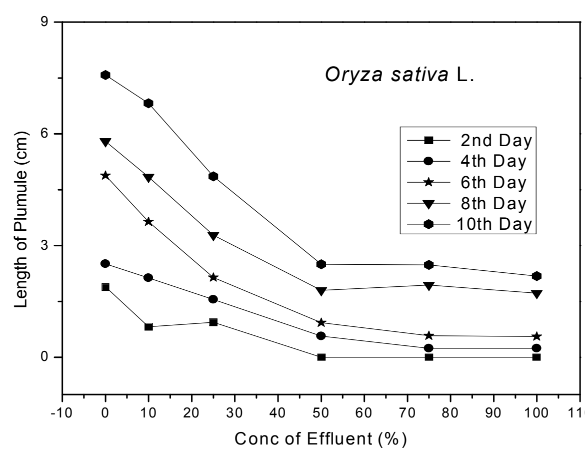

Fig. 6: Effect of effluent concentration on length of plumule in *Oryza sativa.*

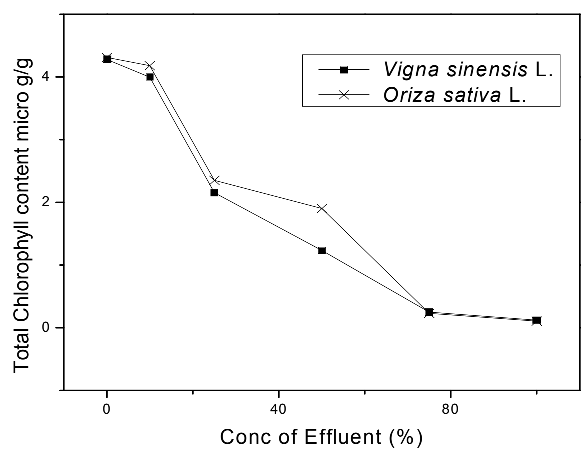

Fig.7: Effect of Effluent on Total Chlorophyll Content (µg/g).

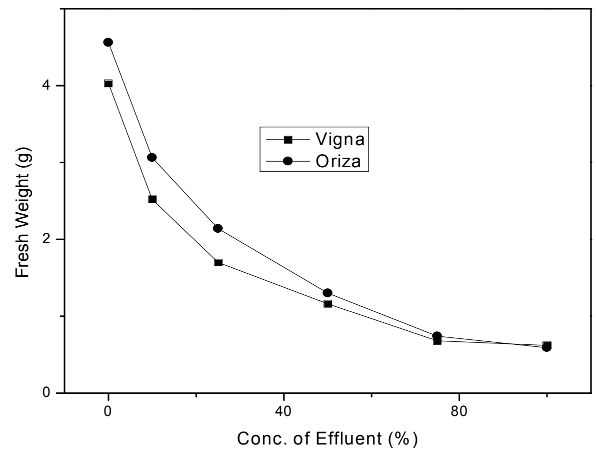

Fig. 8: Effect of Effluent on Fresh weight of seedlings

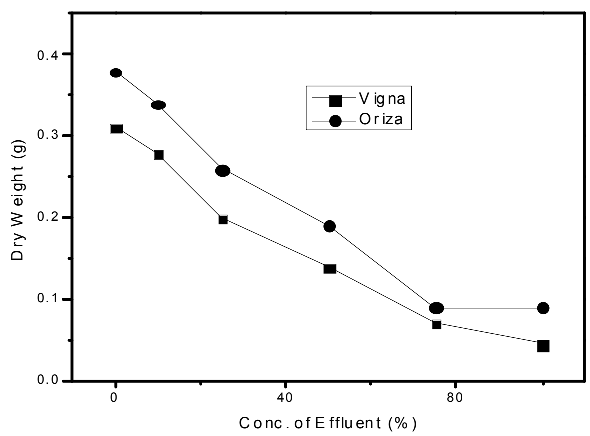

Fig. 9: Effect of effluent on the dry weight of seedlings.

Table 1: Physico-chemical characteristics of the effluent.

Parameter	Concentration
Colour	Colourless
Odour	Aromatic
pH	8.1
TDS	18648 mg/L
DO	0.45 mg/L
BOD	104 mg/L
COD	1829 mg/L
Chloride	650 mg/L
Hardness	880 mg/L
Nitrate	0
Phosphate	0

conductivity of solutes being absorbed by the seeds prior to germination (Swaminathan & Vaidheeswaran 1991).

The seedling growth, recorded as the emergence of the radicle and the hypocotyl, did not show much inhibition in the treatment with 10% concentration of the effluent (Figs. 3 & 4). Both *Vigna sinensis* and *Oryza sativa* showed delay in the emergence of the radicle at 50% and 100% concentrations of the effluent. A decrease in the elongation of the hypocotyl was observed in the 50% and 100% concentrations treatment (Figs. 5 & 6). Similar results were observed by Dhanam (2009) and Chandraju et al. (2013). Malaviya & Sharma (2011) in a study on the impact of distillery effluent on germination behaviour of *Brassica napus* L., observed a decreasing trend of germination of the seed with increasing effluent concentration and attributed it to the lesser uptake of nutrients and increase in the osmotic potential of the soil irrigated with higher effluent concentration.

Fig. 7 reveals the total chlorophyll concentration in 15 days old seedlings after being treated with the effluent. The total chlorophyll content was highest in the 10% treated seedlings of *Oryza sativa* (4.18µg/g), and the lowest in the seedlings of *Oryza sativa* after 100% treatment (0.105µg/g). In general, the total chlorophyll content exhibited a decreasing trend with increasing effluent concentration. The fresh weight of the 15-day old seedlings recorded its maximum in *Oryza sativa* (3.06g) in treatments made with 10% effluent concentration. A minimum of 0.59g was recorded in the same plant when treated with 100% effluent (Fig. 8). The dry weight of the seedlings recorded maximum values in the diluted samples of the effluent, while minimum values of 0.044g were observed in the 100% effluent (Fig. 9). Izawa (1977) suggested the inhibition of electron transport system in PS II. The decrease in the concentration of total chlorophyll under the higher percentage of the effluent may be due to the inhibitory effect of the toxicants in the effluents on chlorophyll synthesis in exposed plants (Nagajyothi et al. 2009).

The above findings lead to the conclusion that undiluted effluent showed maximum inhibition in seed germination, seedling growth and the chlorophyll content, while lower concentrations did not record any marked inhibition. The effluents should be considerably diluted before being released for irrigational purposes, which will not exceed the tolerance limits.

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