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Germination Rate of Tomato (Lycopersicon Esculentum Mill.) Seedling and the Enzyme Activity in Soil Amended with Rice Mill Effluent

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Abstract: *In the presence study the germination potential & the enzymatic activity of soil amended with different concentration of rice mill effluent was performed in Petridis and pot culture. Maximum germination growth takes place in 50 mlL^{-1} as 92% & also there is increase in the enzyme activity such as amylase, invertase, protease, dehydrogenase with increase in concentration level upto 100 mlL^{-1} but decreases at higher concentration i.e 200 mlL^{-1}.*

Keyword: *Rice mill effluent, Amylase, Protease, Invertase, Dehydrogenase*

1. INTRODUCTION

Now-a-days, treated wastewater is considered as a potential water resource because it contains considerable amount of nutrients, which may prove beneficial for plants growth (Sahai et al., 1985 Mishra and Behera, 1991) and hence the use of wastewater in agriculture is gaining importance rapidly. Generally, the quality of discharged effluent differs from industry to industry depending on the nature of raw materials used, the processes involved there in and the type of equipment used in the processes, which may or may not be suitable for the irrigation of crop. So, the effluent should be assessed properly prior to its application for irrigation. However, indiscriminate use of industrial effluent may reduce crop growth and contaminants may interfere with natural characteristics of soil. The pollution problem is increasing due to industrial proliferation and improper management of waste product in our country with a fast growth of variety of industries. All the industries have a social responsibility to protect the environment for future generation. Rice mill industry is one of the largest industries of our country. This is an important agriculture based industry in India. These industries are also an important source of Indian economy.

Rice is one of the most important crops of the world. More than half of the world's population is dependent on rice. Parboiling is a premilling process for paddy which originated in India (Subrahmanyan, 1971). The water needed for paraboiled, if not properly treated could result in water pollution and odour nuisance to residents. Water pollution can be caused by high levels of organic material present in wastewater (Manogari et al., 2008). The volume of effluent generated from sella-rice mill is approximately 900-1000 l ton^{-1} of paddy (Paspia and Desikachar, 1980). This effluent has high BOD, COD and organic contents mainly in the form of starch, so it should be disposed in proper way for agricultural purposes.

2. OBJECTIVES

To determine the effect of rice mill effluent on growth and development of tomato plants& to determine a suitable concentration for best yield and fruit quality.To find the germination percentage of tomato seedling grown under various concentrations of rice mill effluent& also to find the variation in enzyme activity in soil amended with rice mill effluent.

3. MATERIALS AND METHODS

3.1.Test species

Tomato (Lycopersicon esculentum)

Tomatoes are juicy berry fruits of the nightshade family (*Solanaceae*). The seeds were procured from the local seed supplier. The effect of ricemill effluents was studied on tomato pahuja no. 1 variety of tomato.

Rice mill effluent

The rice mill effluents used in the present study were collected in precleaned containers from the Akrura , unit IV rice mill located near Pandakital,sonepur (Odisha), India.

3.2.Plant material & growth condition:

Germination study

For germination tests, 50 seeds were placed in sterilized glass Petri dishes of uniform size lined with two filter paper discs.

These filter discs were then moistened with 5 ml of distilled water for control and with the same quantity of various concentrations of the ricemill effluent (50, 100 and 200 ppm) in petri dishes. The Petri dishes were kept in dark. The emergence of the radical was taken as a criterion of germination.

Pot culture experiment:

Pots of same size were filled with equal amounts of sandy loam soil of medium fertility and 20 seeds of tomato were sown in each pot. The pots were irrigated with selected concentrations of the rice mill effluents. For each treatment, 100ml of each of these was applied to the respective pot at 5-day interval, throughout the study period. A control set, irrigated with distilled water was also maintained for comparison.

3.3.Method for Germination percentage:

The number of seeds germinated in each treatment was counted on 10th day after sowing and the germination percentage was calculated by using the following formula.

Germination % = No. of seeds germinated / Total No. of seeds sown x 100

3.4.Estimation of Enzyme:

Soil amylase & invertase activity was determined following Mishra *et al.* [22]. The enzyme activity was quantified by spectrophotome- ter at 540 nm and expressed in µg glucose g−1 dry soil hr−1.Soil protease activity was determined following the method of Speair and Ross (1975). Tyrosine was used as standard.The activity was expressed in mg tyrosine g $soil^{-1}$ h^{-1}. DHA was determined using the TTC method (Thalmann, 1968). Preliminary experiments showed that for the specific test soils, the addition of 2.5 ml 1.0% TTC (in Tris buffer solution of pH 7.6) to 2.5 g fresh soil incubated at 40^0C in the dark for 24 hours gave the highest activity (Gong, 1995).

4. RESULT

Each experiment was repeated three times. The data are expressed as mean (n=3). The data were analysed by ANOVA using MS Excel software.

The effect of rice mill effluent on the germination of seeds of tomato plant after 10 days of the beginning process of germination was observed &the data was recorded (Fig 1). The germination rate in Control treated plant was found to be 90% whereas seed treated with 50 mll^{-1}, 100 mll^{-1} & 200 mll^{-1} of rice mill effluent was found to be 92%, 88% & 82% (Fig 1). The tomato seeds treated with 50 mgl^{-1}shows maximum germination.

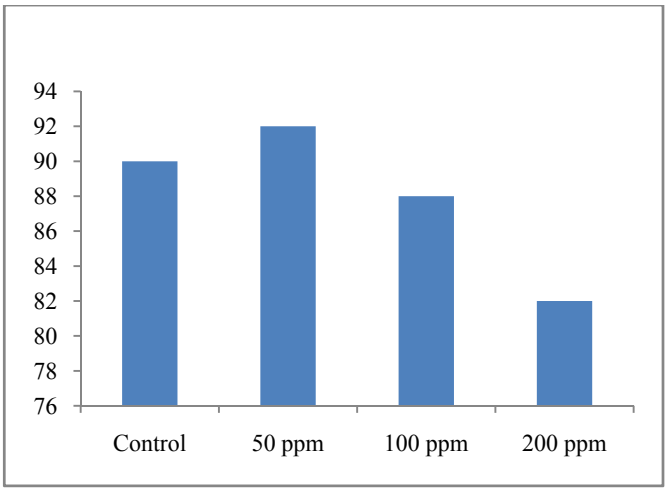

Fig. 1: Germination percentage of tomato seeds in rice mill effluent treated plate culture

In control soil the amylase activity was lower as compared to the soil treated with rice mill effluent with different concentration. Maximum amylase activity was found in soil treated with 100 mlL^{-1} of rice mill effluent on 30^{th} day i.e 39.89mg glucose g $soil^{-1}$ h^{-1} & 46.72 mg glucose g $soil^{-1}$ h^{-1} on 45^{th} day but it decreases at 200 mlL^{-1} concentration i.e 36.92mg glucose g $soil^{-1}$ h^{-1} on 30^{th} day & 44.21 mg glucose g $soil^{-1}$ h^{-1} on 45^{th} day& also the enzyme activity increases with the increase in days (Fig 2).Significantly enzyme activity increases with increase in concentration of rice mill effluent upto 100 mlL^{-1} & also with increase in the days of observation at 100 mlL^{-1} 46.72mg glucose g $soil^{-1}$ h^{-1}.(1414(Fc) > 10.127(Ft) from day to day & 33.28(Fc) > 9.27 (Ft) at different concentration level).

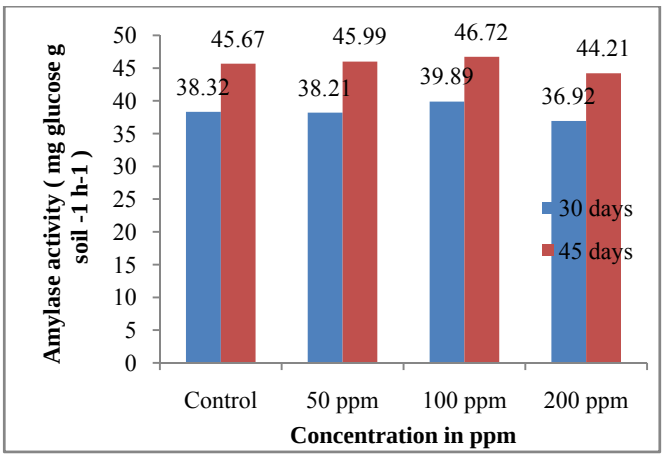

Fig. 2: Amylase activity of soil amended with different concentration of rice mill effluent.

Invertase activity was found maximum i.e 33.16 mg glucose g $soil^{-1}$ h^{-1}in 100 mlL^{-1} of soil treated with rice mill effluent on 30^{th} day & 39.11 mg glucose g soil g^{-1} h^{-1}in 100 mlL^{-1} on 45^{th}

day as compared to control i.e 31.42 mg glucose g soil^{-1} h^{-1}on 30th day & 39 mg glucose g soil^{-1} h^{-1} 0n 45th day but the invertase activity decreases with increase in concentration more than 100 mlL^{-1}i.e 30.21 mg glucose g soil $^{-1}$ h^{-1} at 30th day & 37.86 mg glucose g soil $^{-1}$ h^{-1} at 45th day in 200 mlL^{-1} of soil treated with rice mill effluent(Fig 3).. The present study shows significant increase of invertase activity as the day increases but no significant difference was found at different level of concentration.(142.7(Fc)> 10.12(Ft) from day to day & 2.35(Fc) < 9.27 (Ft) at different concentration level).

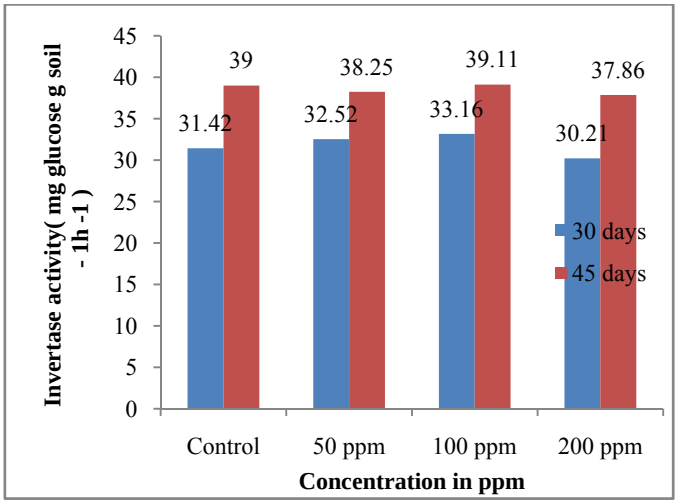

Fig. 3: Invertase activity of soil amended with different concentration of rice mill effluent.

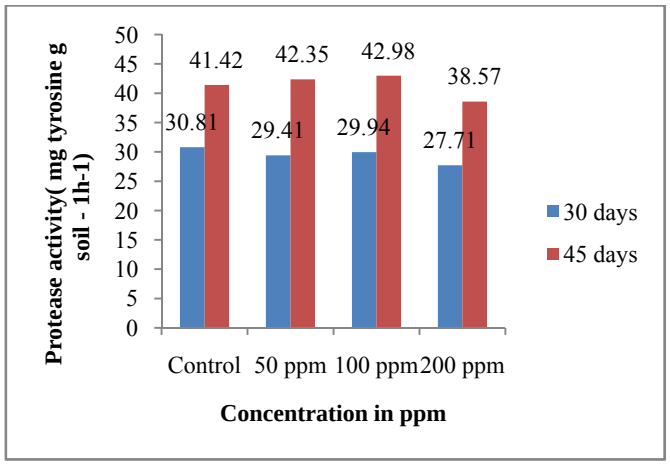

Fig. 4: Protease activity of soil amended with different concentration of rice mill effluent.

Maximum protease activity was found in soil treated with control on 30th day i.e 30.81 mg tyrosine soilg^{-1} h^{-1} as compared to different concentration levelbut as the days increases maximum protease activity was found upto 100 mlL^{-1} i.e 42.98 mg tyrosine soil g^{-1} h^{-1} (Fig 4). It shows highly significant difference with increase in days of observations but no significant difference was found at different concentration of rice mill effluent.(329.72(Fc) > 10.12(Ft) from day to day& 5.44(Fc) <9.27 (Ft) at different concentration level).

Dehydrogenase activity increases in 100 mlL^{-1} of rice mill effluent on 30th day i.e 23.78 µg formazan g soil^{-1} h^{-1}& 33.78 µg formazan g soil^{-1} h^{-1} on 45th day as compared to control i.e 22.93 µg formazan g soil^{-1} h^{-1} on 30th day & 30.24 µg formazan g soil^{-1} h^{-1} on 45th day but as the concentration level increases more than 100 mlL^{-1}, the enzyme activity decreases i.e 20.27 µg formazan g soil^{-1} h^{-1}on 30th day & 28.79 µg formazan g soil^{-1} h^{-1} on 45th day (Fig 5). Significantly the dehydrogenase enzyme activity increases with the increase in day& also at different concentration of rice mill effluent in soil.(209.40(Fc) > 10.12(Ft) from day to day & 9.38 (Fc) > 9.27 (Ft) at different concentration level).

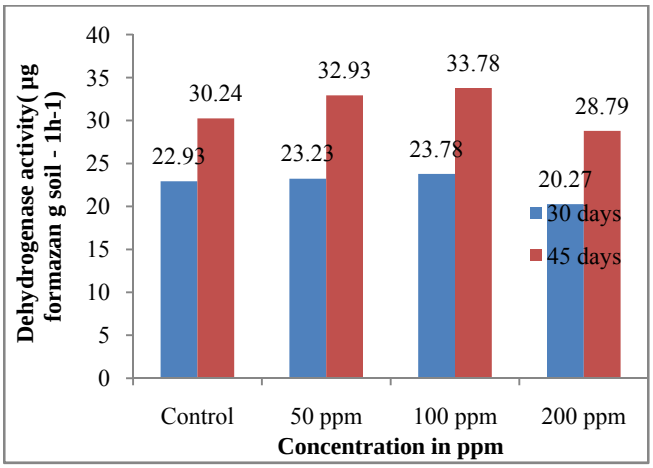

Fig. 5: Dehydrogenase activity of soil amended with different concentration of rice mill effluent.

5. DISCUSSION

The present study shows the effect of rice mill effluent on the germination of tamato seed. Exposure to rice mill effluent increase normal germination & maximum germination takes place when 50 mll^{-1} of rice mill effluent was applied as compared to control treated plant. The results from the present study are in consistence with the result of Borole, D.D. & P.R. Patil, 2004 & Baskaran, L, 2009. They reported that, the higher concentration of effluent reduced the germination of seeds due to the presence of excessive dissolved solids & high BOD in sago effluent & also be attributed to acidic pH associated with chloride compounds in the effluent.

Amylase activity shows higher when it increases from days of observation& at different concentration in the present study. Amylase is complex enzymes that hydrolyze starch to reducing sugar. Amylase activity increases due to the presence

of different physicochemical parameters found in the rice effluent. (Achuba, 2006) also found the increase in amylase activity in AS as compared to PTS can be explained due to the pesticide induced changes in starch degrading enzyme(Achuba, 2006), and unavailability of nutrients thus inducing stress (Anigboro and Tonukari, 2008).

Comparisons of invertase activity showed similar trend like that of amylase activity i.e., progressive increase with increase in days& at different concentration level due to presence of nitrate in rice mill effluent. (Shi *et al*., 2008) also shows increase in invertase activity and Nmineralization from FMS to FS was directly correlated with soil organic carbon in his research work.

The protease activity was found to be higher in soil treated with rice mill effluent as compared to control soil. Protease activity also increase in Sardans and Penuelas, (2005) research work. They found protease activity depends on the distribution of proteolytic bacteria and the amount of proteinaceoussubstrate availability in the soil organic matter. The increase in protease activity from FMS to FS is closely related to the progressive improvement in organic carbon,NH4-N accumulation.

Dehydrogenase is an intracellular oxidoreductase group of enzymes regulating the metabolic reactions in soil (Smith *et al*., 1983), and is considered to be an index of microbial activity (Dick, 1994, Alef and Nannipieri, 1995, Stepniewska *etal*., 2007) and metabolic status of soil microorganisms (Beyer *et al*., 1992, Pascual *et al*., 1998, Taylor *et al*., 2002). In my present study also the data showed increase in dehydrogenase activity from day to day & also at different level of concentration.

6. CONCLUSION

The present study concluded that the higher concentration of effluent exert more stress on the germination potential of tomato plant where as the lower concentration effluent enhance the plant germination rate as well as the soil enzymatic activity. The rice mill effluent content high amount of nutrient such as sodium & Potassium at desired concentration which enhance the plant growth potential. So, the lower concentration of rice mill effluent can be amended with the soil not only to gain better yield of crops but also to reduce the disposal problems relating to rice mill effluent.

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