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Germination Behaviour of Pea Seeds on Municipality Sewage and Some Industrial Effluents of Biratnagar.

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Abstract

Municipality sewage and effluents from Dairy Farming and Shah Udyog were chosen to assess the germination activity of Pea (*Pisum sativum* L. var. *arkel*). The effluents from Municipality Sewage and Dairy Farming inhibited seed germination while Shah Udyog effluent promoted. The effluent from Municipality Sewage and Dairy Farming delayed seed germination during early hours i.e., 24 hours of sowing. The inhibition was maximum in the Municipality Sewage effluent where as the germination percentage never exceeded 48% even after 120 hours of sowing. The dilution experiment revealed that the effluent of Municipality Sewage was still inhibitory upto 25% (v/v) concentration while the inhibitory effect of Dairy Farming was overcome at 50% (v/v) concentration. The Shah Udyog effluent was safe for seed germination at all dilution.

Keywords: Effluent, Seed Germination, Inhibition and Promotion

Introduction

Biratnagar (Lat. N 26°26', Long. E 87°16') is the second largest city and the largest industrial area of Nepal. Several industries, banks, shops, cinema-halls, government and private offices, hospitals, hotels, schools, and colleges operate there. The liquid waste of this city is discharged mainly to the Singhia River through municipal sewage. The untreated industrial effluents are similarly discharged directly into the neighbouring water bodies or onto agricultural land. The water thus contaminated is being used by farmers of this area to irrigate their crop field. The use of such polluted water in irrigation adds plant nutrients to some extent thereby increasing fertility of soil but also includes toxicants that changes soil property and micro-flora. It is necessary to investigate the effects of effluents on different parameters before using them in irrigation with particular soil and climate.

Several works have been done regarding the impact of effluents on germination of crops (Timsina 1988, Ghimire and Bajracharya 1996, Niroula 1998, Jha and Niroula 1998, Shrestha 2000). Present work is intended on germination behaviour of pea seeds at different dilutions to find out the effect of effluents. The effluents for this experiment were selected from Municipality Sewage and two industries viz., Shah Udyog and Dairy Farming, Biratnagar.

Materials and Methods

The tested seeds of Pea were stored in airtight plastic bottle in dark room under ambient conditions. The Municipality Sewage was collected from the discharge point of the sewer of Biratnagar Municipality, located at the bank of Singhia River. The effluents were collected directly from the outlet of the factories. The containers were thoroughly cleaned with tap water and rinsed thrice

with the effluent sample before collection. The effluents were stored inside the airtight polythene containers in dark room under ambient conditions. The colour (visual appearance), pH (pH meter method), dissolved oxygen (Winkler's method), solute particles (Zobel *et al.* 1987) and organic matter (Michael, 1984) were recorded within three days of sample collection.

Germination experiments were carried out in petridishes (diameter 10.5 cm) in triplicates under room conditions (25±2°C). Before sowing, seeds were sterilised with 70%) alcohol and were soaked for 24 hours in filtered undiluted (100%) or diluted (75%, 50% and 25%) effluent solutions/ tap water. Thereafter, 15 seeds were sown at equidistant in sterilised petridishes lined with two ordinary filter paper. Three ml of effluent solution/ tap water was added into each petridish. At the interval of 24 hours, 2 ml of effluent solution/ tap water was added to each petridish to keep them moist. The percentage of seed germination was determined at the interval of 24 hours. The emergence of radicle of 2 mm length was taken as criterion for germination. The experiments were conducted in 1998.

Results and Discussion

The observation revealed, Dairy Farming effluent was associated with high pH (7.4) and small amount of organic matter. The Municipality Sewage contained high organic matter while high solute particles (1.7 g/l) was found in Shah Udyog effluent. The highest value of dissolved oxygen (4.15 mg/l), lowest value of solute particles (0.4 g/l) and negligible organic matter were found in tap water (Table 1).

Not all the effluents affected uniformly in seed germination. Effluents from Dairy Farming and Municipality Sewage inhibited germination while Shah Udyog promoted comparatively. The inhibition on seed germination was more pronounced during the early hours i.e., 24 hours of sowing. No seeds were found germinated before 24 hours when treated with undiluted Municipality Sewage and Dairy Farming effluent. On the other hand, the percentage of seed germination in Shah Udyog effluent exceeded the other two effluents including control in later hours. The inhibition was maximum in the Municipality Sewage effluent where the germination percentage never exceeded 48% even after 120 hour of sowing while promotion in germination percentage was observed in Shah Udyog effluent (69%) in comparison to control (67 %) (Figure 1).

1. Comparative effect of undiluted effluents on seed germination of *P. sativum.*

The effect of effluents in seed germination at different concentration is shown in figure 2 (a, b, c). It is evident from the figure that effluent from Municipality Sewage is inhibitory at all dilution while inhibitory effect of effluent from Dairy Farming was overcome at 50% concentration. The diluted Shah Udyog effluent further promoted seed germination.

Of all the developmental phases of a plant, germination is most subject to control by the environment (Sen 1977, Mayer and Poljakoff-Mayber 1982). Many foreign substances to the seed environment such as diverse acids, alkali, salts of metals, phenolics, fluorides, and so on from polluted water influence germination (Shrestha 2000). During imbibitions of water, the dissolved toxicants also enter inside the seed thereby affecting other physiological process of seed germination or decrease in osmotic entry of water due to high concentration of solute such as oils,

grease, metallic wastes, suspended solids, phenols, heavy metals (Fe, Cu, Zn, Pb) etc. The Municipality Sewage receives the discharge of liquid waste of colleges, hospitals, hotels, nursing homes and large number of household by-products that may contain high amount of organic and inorganic toxicants inhibitory for seed germination. The Dairy Farming effluent on the other hand may have less amount of inorganic toxicants but more organic ones as it involves more biological action on the milk and its products. Similarly, Shah Udyog effluent contains different classes of dyes including naphthol, sulphur chromate, basic and direct dyes used in cotton fabric production. Some of these dyes contain toxic chemicals e.g., Chromium (NPC/ IUCN 1992).

Our investigation revealed that Municipality Sewage proved inhibitory in seed germination at all dilution. It may be due to higher concentration of heavy metals (Timsina 1988) that are known to be binding with – SH groups of amino acids and thereby inhibiting water imbibitions by the seeds at earlier periods of germination. The Dairy Farming effluent followed almost the same trend as that of Municipality Sewage under undiluted condition but the diluted effluent gradually decreased the inhibitory effect and promoted seed germination. Ghimire and Bajracharya (1996) also reported different germination behaviour of vegetable seeds (*Brassica juncea*, *B. rapa*, *B. oleraceae* and *Raphanus sativus*) of a single family (Brassicaceae) to the effluents of Carpet Dyeing, Tannery and Steel industries. They reported decrease in toxicity of effluents on seed germination with dilution but Steel effluent didn't decrease appreciably. The Shah Udyog effluent on the other hand remained stimulatory in seed germination in all cases in our experiment. This effluent also promoted seed germination of *Vigna mungo* (L.) Hepper (Jha and Niroula 1998) that may be due to presence of certain stimulatory toxicants that doesn't affect osmotic entry of water but accelerates the physiological processes of seed germination.

Though the industrial and municipal sewage effluents may contain some useful organic and inorganic nutrients required for plants, their more toxic nature than useful property suggests not bringing them in use for irrigation without proper treatment. It is also indispensable to treat the effluent chemically before discharge to the surrounding water bodies to minimise water pollution and to save the quality of soil and surrounding air.

Table 1. General characteristics of effluents and tap water.

S. N.	Effluents/Tap water	Parameters				
		Colour	Solute (g/l)	D.O. (mg/l)	Organic matter	pH
1.	Dairy Farming	Silvery white	1.4	3.0	Only small amount	7.4
2.	Municipality Sewage	Blackish	1.5	2.5	High	7.1
3.	Shah Udyog	turbid	1.7	3.6	Moderate	7.1
4.	Tap water (Control)	Violet	0.4	4.15	Negligible	6.9

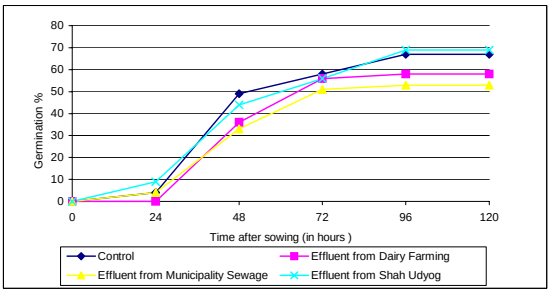

Figure 1. Comparative effect of undiluted effluents on seed germination of *P. sativum.*

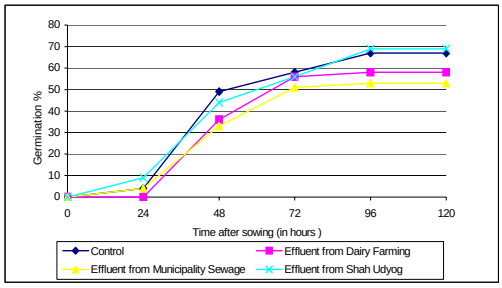

Figure 2. (a) At 75 % concentration

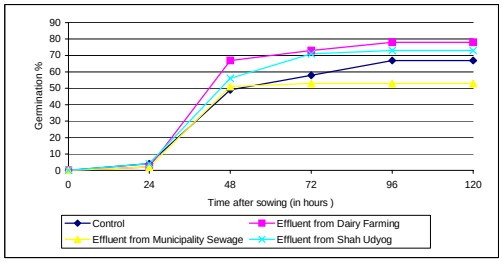

Figure 2. (b) At 50 % concentration

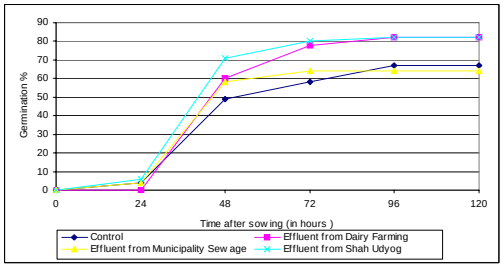

Figure 2. (c) At 25 % concentration

Figure 2. (a, b, c). Comparative effect of effluents at different concentration on seed germination of *P. sativum.*

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