Eco. Env. & Cons. 26 (2) : 2020; pp. (606-611)
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ISSN 0971–765X

Effect of vegetable oil mill effluents on seed germination and seedling growth of *Glycine max* (L.)

Regar Durgalal and Jaiswal Poonam*

J.D.B. Govt. Girls College, Kota, Rajasthan, India

(Received 1 September, 2019; accepted 8 November, 2019)

ABSTRACT

Present study was carried out to assay the effects of vegetable oil mill effluents on soybean. For that purpose Soybean oil mill effluent and Mustard oil mill effluent were taken. Different concentrations (0% control, 20%, 40%, 60%, 80% and 100% OME) were used for both the effluents. Seeds of *Glycine max* (L) variety *Pratap Soya 1* were used to test the effect of different concentration of effluents on seed germination and seedling growth. Physicochemical characteristics of these effluents revealed that both of them contained high amounts of sulphates, nitrates, calcium, various heavy metals etc., while DO was very low, which confirms their highly polluted conditions. Maximum seed germination percentage was found in control (0% OME) as well as in experimental set with 20% OME in both the treatments. Seed germination shows decreasing trend with further increase in OME concentration. Results show that lower concentrations enhanced the growth in early stages of development in Mustard OME but during later stages growth shows decreasing trend in both the treatments.

Key words: *Oil mill effluent, Seed germination, Seedling growth.*

Introduction

In recent years industrial effluent related pollution has come out as serious concern worldwide. In most of the cases effluents are discharged with or without treatment into nearby agricultural fields or water bodies. This causes serious contamination of soil and water which is associated with many diseases (WHO, 2002).

In India, 13,500 Million Litres per Day (MLD) industrial wastewater is generated and the treatment capacity available for industrial wastewater is only for 8,000 MLD (CPCB report, 2005). Data presents only 60% of the total waste water generated by industries is treated before discharging (Kaur *et al.*, 2012) and rest discharged untreated into nearby soil or water bodies. Discharge of untreated effluent into water body results indecrease of water pH, and an increase of temperature, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), turbidity, heavy metals and toxic chemicals (Santiniketan and Vishva- Bharti, 1994). Hence these industrial effluents are the most potential source of water and soil pollution.

In the recent past alternative use of industrial effluent in irrigation has emerged as an important way of reusing waste water. Due to scarcity or limited availability of water and being rich in essential nutrients these effluents are being used for irrigation especially for raising vegetables and fodder (Ghafoor *et al.*, 1994). This can be advantageous because of the presence of considerable quantities of N, P, K and Ca along with other essential nutrients (Niroula, 2003). Continuous use of industrial effluents in agriculture has some negative effects also. Industrial effluents contain heavy metals as well as nutrients which affect soil and plants in variety of ways (Dhevagi and Oblasam, 2002). Thus keeping in mind both the beneficial and damaging effects of waste water for irrigation on crops (Raman *et al.*, 2002; Saravanamoorthy and Ranjitha Kumari, 2007) it is necessary to evaluate the impact of industrial effluents on crops before recommended for irrigation (Thamizhiniyan *et al.,* 2009).

There are a number of studies on the impact of industrial or domestic effluents on soil properties and crop response (Sharma *et al.,* 2007; Singh and Agrawal, 2010). Most of the studies conducted so far are based on Palm oil mill effluent (POME). Studies regarding the effect of vegetable oil mill effluent mainly Soybean and Mustard oil mill effluent is scanty. Thus keeping in mind the recycling and reuse of industrial waste water the present study was conducted to study the effect of vegetable oil mill effluent on germination and seedling growth of *Glycine max* (L) in the area under study. Another aspect of the study was to evaluate the potential of industrial effluents as source of irrigation, which may reduce the water scarcity issue.

In Bundi district of Rajasthan, India there are two vegetable oil mills; one is mustard oil mill and another soybean oil mill. Both the mills are working for the last 20-30 years. BungeIndia Private Limited is working from 1997 in Ramganjbalaji and Adani Wilmer Limited working since 1990 in Silor Road in Bundi district of Rajasthan India. As claimed by administration of the mills, the effluent produced by these oil mills are transported to other cities where the effluents are treated further to make it suitable for reuse. Soybean is the major crop in the study area which is grown in 83805 ha land area with annual production of 102683 MT and the productivity of soybean in 1230 Kg/ha according to District agriculture department in 2014-15.

Methodology

Effluents taken from two oil mills (Soybean and Mustard oil mill) were collected and stored at 4ºC to avoid changes in their physico-chemical properties. Effluent was subjected to different tests for physic-chemical analysis. pH, electro-conductivity, total dissolved solids, total suspended solids, organic carbon, Nitrogen, Phosphorus, Potassium, Zinc, Iron, Copper, Manganese, oil and greases and COD were determined using Standard methods (Clesceri *et al.,* 1998). Certified seeds of *Glycine max* (L) variety *Pratap Soya1* were obtained from local market. Healthy and seed of uniform size were collected and sterilized with 0.1% $HgCl_2$ for 2 minutes and thoroughly washed twice to remove traces of $HgCl_2$ and other contamination. The seeds were then soaked in distilled water for 2-3 hours.

20%, 40%, 60%, 80% and 100% effluent concentrations were prepared along with control (0% effluent) for 2 sets of experiments; one with Soybean OME and other with Mustard OME. 10 seeds of *Glycine max* (L)were placed equidistantly in pre-labelled petri-dishes containing filter papers soaked with water. Then 5 mL of each prepared concentrations of both effluents ware added in two separate sets of treatments and then kept in dark for 48 hours for germination. For each treatment 6 replicates were prepared. The numbers of seed germinated in each treatment were counted at 24, 48, 72, 96, 120, 144, 168, 192, 216 and 240 hours of experiment and germination percentage was calculated using following formula.

(GP %) = g/10 x100

As g is the number of germinated seeds and 10 is the total number of seeds

Seedlings were harvested after 7th, 15th, 30th and 45th days of growth and data recorded for percentage germination, root length (cm), shoot length (cm). Data collected was subjected to statistical analysis using Analysis of Variance (ANOVA).

Results

Results show that in Treatment 1 (with soybean oil mill effluent) control seed germination occurs at 4th days while in higher concentration germination is delayed as it occurs on 7th and 9th day in 80% and 100% effluent concentration. Highest germination occurs in 0% effluent and lowest in 100% OME. In treatment 2 (with mustard oil mill effluent) result shows that control seed germination occurs at 4th day, while with increasing OME concentration germination is delayed. But with respect to Soybean OME, germination with Mustard OME shows less negative effect. With 80% and 100% effluent concentration germination occurs on 6thand 7thday respectively. Highest germination occurs in 0% effluent and lowest in 100% OME.

Both the soybean and Mustard OME shows same trend *i.e.* with increasing concentration of OME from 0-100%, root and shoot length decreases. The decrease is more prevalent after 15 day of germina-

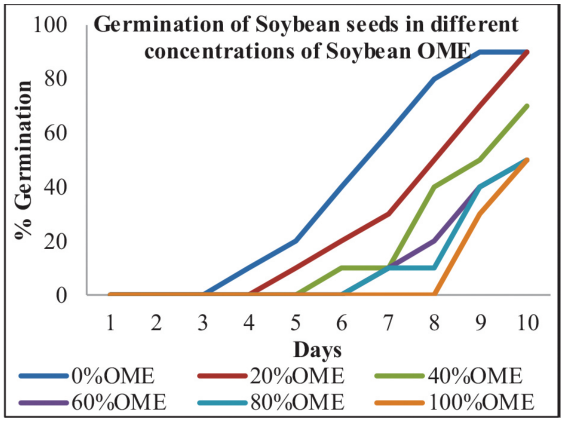

Fig. 1. Treatment 1(Seed germination percentage and germination time with Soybean oil mill effluent)

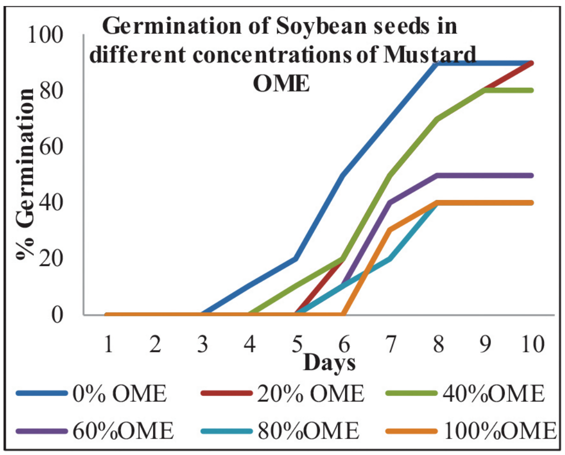

Fig. 2. Treatment 2 (Seed germination percentage and germination time with Mustard oil mill effluent)

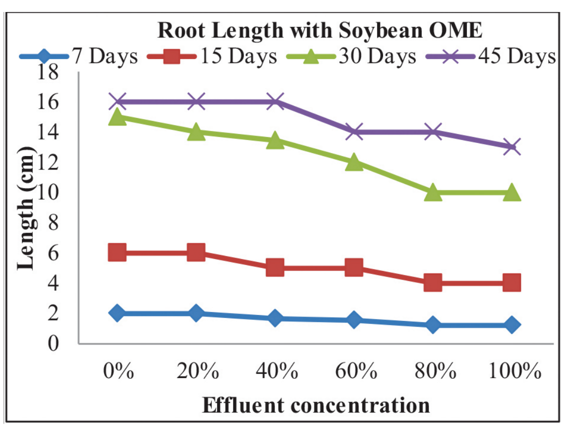

Fig. 3. Pattern of root length development in different concentrations of Soybean OME.

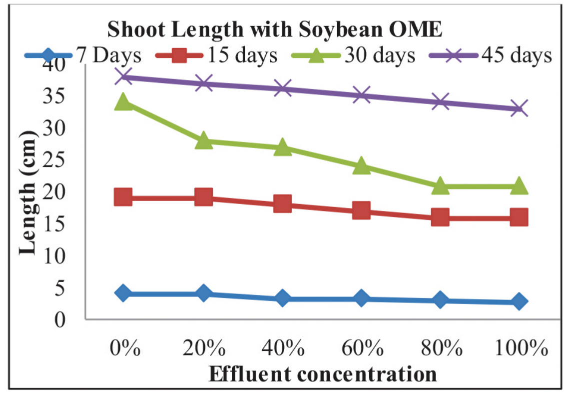

Fig. 4. Pattern of shoot length development in different concentrations of Soybean OME.

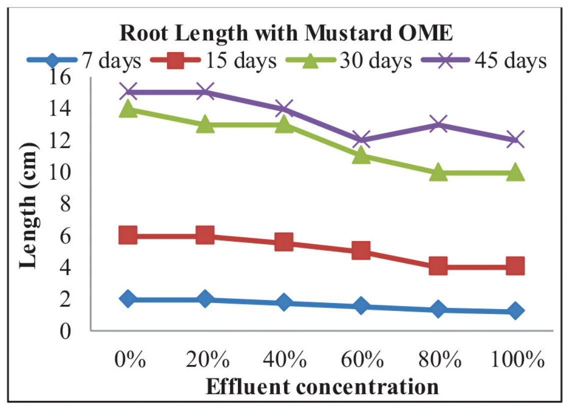

Fig. 5. Pattern of root length development in different concentrations of Mustard OME.

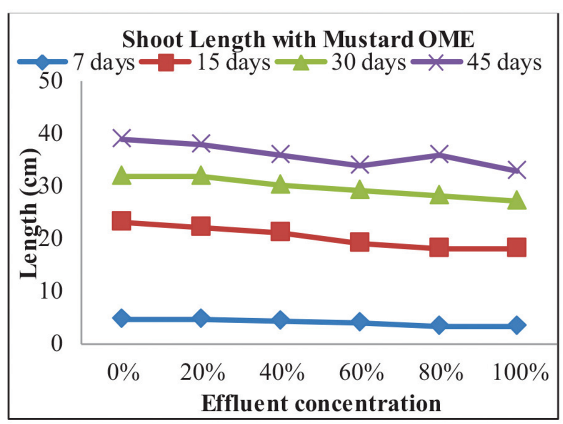

Fig. 6. Pattern of shoot length development in different concentrations of Mustard OME.

tion. Root development is more affected with Mustard OME whereas shoot length is more negatively affected with Soybean OME.

The data of seed germination under different efluent were subjected to ANOVA test for assessing the significance of differences in effluent treatments

Table 1. Physico-chemical Characteristic of Soil and Oil Mill Effluent:

S.N.	Parameters	Samples		
		Control (without Effluent)	Soybean oil mill effluent	Mustard oil mill effluent
1	pH	7.50	6.95	6.85
2	Total dissolved solids	-	3000	3010
3	Total suspended solids	-	120	140
4	EC (dsm^{-1})	0.35	0.30	0.34
5	Organic Carbon%	0.45	0.37	0.36
6	Nitrogen (Kg/hect)	344	318	310
7	Phosphorus (Kg/hect)	48	42	40
8	Potassium (Kg/hect)	425	417	388
9	Zinc (ppm)	3.62	3.62	3.52
10	Iron (ppm)	20.94	19.27	15.07
11	Copper	2.17	2.15	1.62
12	Manganese (ppm)	58.90	44.14	31.59
13	Oil & greases (ppm)	-	100	90
14	COD (ppm)	-	110	98

Table 2. ANOVA Table

Variation	Degree of freedom	Sum of squares	Mean square	F
Treatment	5	4366.66	873.33	17.46
Error	6	300	50	
Total	11	466.66		

in *Glycine max* (L).

Conclusion and Discussion

The critical value of F for $\alpha = 0.05$ is 4.39. Since calculated value of F; 17.46 is greater than 4.39, the null hypothesis is rejected and it may be concluded that the two effluents have different effects on seed germination. At lower concentrations of effluent seed germination and early seedling growth is not negatively affected but at higher concentration negative effect is prevalent in both the treatments.

The effluent or waste water generated in vegetable oil mills are mostly discharged either without any treatment directly into soil or nearby water-bodies with partial treatment only for oil removal. Sewage and other industrial effluents rich in organic matter and plant nutrients are finding agricultural application as cheaper way of disposal (Nath *et al.*, 2009; and Nagajyothi *et al*., 2009).

In India, the abundance of soils with low organic matter content, favours the use of industrial waste-waters containing organic matter as an organic amendment and nutrient supply to soil. Although irrigation with wastewater has numerous benefits but precautions should be taken to avoid related short and long-term environmental risks. Oil mill effluents require adequate treatment before discharge into inland surface water or for land use to conform effluent discharge standards prescribed by the regulatory agencies (Pathe *et al*., 2000). Earlier studies have shown that the effect of an industrial effluent vary from crop to crop (Kaushik *et al*., 2005).

According to Rodosevich *et al.* (1997) seed germination control plants populations, ensure reproduction and crop productivity. Accumulation of heavy metals in soil results in reduced fertility of soil. In case of plants, heavy metals accumulates in the living cells causing a reduction of cell activities, inhibits the growth of plants and causes various deficiencies/ diseases in plants (Shafiq and Iqbal, 2005; Kabir *et al.*, 2008; Farooqi *et al.*, 2009). Many researchers related decrease germination at high concentration of different effluents with high osmotic pressure of these effluents (Ramana *et al*., 2002; Nagada *et al.*, 2006). The results of the studies revealed that industrial water and domestic sewage water had negative impact on seed germination (Khan *et al.*, 2011 and Nagda *et al.*, 2006) and in higher concentration industrial waste water effect seed germination rate. There are probabilities that some essential organic compounds present in waste waters may alleviate some part of negative impacts. According to Panasker and Pawar (2011a, b) at low concentration of polluted water seedling growth is not inhibited but at higher concentration germination of seeds and seedlings growth will be negatively affected. On the contrary some researcher also reported that waste water contain some essential organic compound which increases growth of crop (Pathak *et al.,* 1999; Ramana *et al*., 2001; Lubello *et al.,* 2004; Nath *et al*., 2009; Nagajyothi *et al.*, 2009). The results of the present study show similarity with the results of Bazai and Achakazai (2006) and Otobbang *et al.*, (1997), who suggested that plumule length is decreasing in higher concentration of polluted water. Augusthy and Sherin (2001) stated that root length of *Vigna radiata* increase in low concentration of effluents.

It has been reported that irrigation with sewage or sewage mixed with industrial effluents results in saving of 25 to 50% of N and P fertilizer and leads to 15-27 % higher crop productivity, over the normal waters (Anonymous, 2004). By selecting the tolerant species waste water could be considered as potent waters for irrigation. Thus it is essential to study the effect of industrial effluents on individual crops before their use in agricultural fields. The use of domestic wastewater in plant nourishment would be beneficial alternative resources to fresh water.

However, results also suggested that, treatment of sewage is necessary to minimize the pollution effects before it is discharged to the land sources of irrigation water (Sofia *et al*., 2006). Biochemical oxygen demand removal efficiency of tree plantations has also been observed to be 80.0 to 94.3% (Thawale *et al.,* 2006). Under the situations where land has already been contaminated and food crops are not permitted; alternate land uses like establishment of manmade forests with high economic value and having high rate transpiring trees like Sisal, Mahogany, Eucalyptus, Poplar, Bamboo, Neem (*Azadirachta indica*), Shisham (*Dalbergia sissoo*) etc. for nonedible products like fuel and timber and developing green belts around the cities can be another approach to overcome health hazards. Under such systems, the quality of groundwater has been observed to be not affected by effluent applications and the heavy metals in soil have also been observed to be low.

References

Anonymous, 2004; NATP – MM project report on "Use of Urban and Industrial Effluent in Agriculture" CSSRI, Karnal, 132001, India.

Augusthy, P. O. and Sherin, M.A. 2001. Effect of factory effluents on seed germination and seedling growth of *Vigna radiate* L. *Journal of Environmental Research*. 22: 137–139.

Bazai, Z. A. and Achakzai, A. K. K. 2006. Effect of waste water from Quetta city on germination and seedling growth of Lettuce (*Lactuca sativa* L.). *Journal of Applied Science*. 6 : 380–382.

Clesceri, L.S., Greenberg, A.E. and Eaton, D.A. 1998. *Standard Methods for the Examination of Water and Waste Water.* 20thEdn. Am. Pub. Health Assoc. USA.

CPCB. 2005. News Letter. Central Pollution Control Board, Ministry of Environment and Forests, Govt. of India, Parivesh Bhawan, East Arjun Nagar, Delhi 110 032 http://cpcbenvis.nic.in/cpcb_newsletter/sewagepollution.pdf.

Dhevagi, P. and Oblisami, G. 2002. Effect of paper mill effluent on germination of agricultural crops. *J. Ecobiol.* 4 : 243-249.

Farooqi, Z.R., Iqbal, M.Z., Kabir, M. and Shafiq, M. 2009. Toxic effects of lead and cadmium on germination and seedling growth of *Albezia lebbeck* (L.) Benth. *Pak. J. Bot.* 41 : 27-33.

Ghafoor, A., Rauf, A., Arif, M. and Muzaffar, W. 1994. Chemical composition of effluents from different industries of the Faisalabad city. *Pak. J. Agri. Sci.* 31: 367-369.

Kabir, M., Iqbal, M.Z. and Farooqi, Z.A. 2008. Reduction in germination and seedling growth of *Thespesia populnea* L. caused by lead and cadmium treatments. *Pak. J. Bot.* 40 : 2419-2426.

Kaur, R., Wani, S. P., Singh, A. K. and Lal, K. 2012. Wastewater production, treatment and use in India. National report presented at the *2nd regional workshop on safe use of wastewater in agriculture,* May 16-18, 2012, New Delhi, India. http://www.ais.unwater. org/ais/pluginfile.php/356/mod_page/content/111/CountryReport_India.pdf. Accessed 04 July 2019

Kaushik, P., Garg, V. K. and Singh, B. 2005. Effect of textile effluent on different cultivar of wheat. *Biores. Technol*. 96 : 1189-1193.

Khan, M.G., Danlel, G., Konjit, M., Thomas, A., Eyasu, S.S. and Awoke, G. 2011. Impact of textile waste water on seed germination and some physiological parameters in pea (*Pisum sativum* L.), Lentil (*Lenses culentum* L.) and gram (*Cicer arietinum* L.). *Asian Journal of Plant Science.* 10 : 269–273.

Lubello, C., Gori, R., Paolo, N.F. and Ferrini, F. 2004. Municipal-treated waste water reuse for plant nurseries irrigation. *Water Research*. 38 : 2939–2947.

Nagajyothi, P.C., Dinakr, N., Suresh, S., Udaykiran, Y., Suresh, C. and Damodharam, T. 2009. Industrial effluent on the morphological parameters and chlorophyll content of green gram (*Phaseolus aureus* Roxb). *Journal of Environmental Biology.* 30 : 385–388.

Nagada, G.K., Diwan, A.M. and Ghole, V. S. 2006. Seed germination bioassays to assess toxicity of molasses fermentation based bulk drug industry effluent. *Eur. J. Environ. Agri. Food Chem.* 5 : 1598-1603.

Nath, K., Singh, D., Shyam, S. and Sharma, Y.K. 2009. Phytotoxic effects of chromium and tannery effluent on growth and metabolism of *Phaseolus mungo* Roxb. *Journal of Environmental Biology*. 30 : 227-234.

Niroula, B. 2003. Comparative effects of industrial effluents and submetropolian sewage of Biratnagar on germination and seedling Growth of rice and blackgram. *Our Nature.* 1 : 10–14.

Otobbang, E., Sadovnikova, L., Lakimenko, O., Nilsson, I. and Persson, J. 1997. Sewage sludge: Soil conditioner and nutrient source. II. Availability of Cu, Zn, Pb, and Cd to barley in a pot experiment. *Acta Agriculture Scandinavica*, *Section B, Soil and Plant Science*. 47: 65–70.

Pathe, P.P., Kaul, S.N. and Nandi, T. 2000. Wastewater management in vegetable oil industries. *Indian Journal of Environmental Protection.* 20 (7) : 481-492.

Panasker, D. B. and Pawar, R.S. 2011a. Effect of textile mill effluent on growth of *Vigna unguiculata* and *Pisum sativum* seedlings. *Indian Journal of Science and Technology*. 4 : 266–272.

Panasker, D. B. and Pawar, R.S. 2011b. Effect of textile mill effluent on growth of *Sorgham vulgare* and *Vigna aconitifolia* seedlings. *Indian Journal of Science and Technology.* 4 : 273–278.

Pathak, H., Joshi. H.C., Chaudhary, A., Chaudhary, R., Kalra, N. and Dwivedi, M.K. 1999. Soil amendment with distillery effluent for wheat and rice cultivation. *Water, Air and Soil Pollution*. 113 : 133–140.

Ramana, S., Biswas, A.K., Singh, A.B. and Yadava, R.B.R. 2001. Relative efficacy of different distillery effluents on growth, nitrogen fixation and yield of groundnut. *Bioresource Technology.* 81 : 117–121.

Ramana, S., Biswas, A.K., Kundu, S., Saha, J.K. and Yadava, R.B.R. 2002. Effect of distillery effluent on seed germination in some vegetable crops. *Bioresource Technol*. 82 : 273-275.

Rodosevich, S., Holt, J., Ghersa, C. 1997. *Weed Ecology, Implications for Management.* Wiley Publishers, New York, USA.

Santiniketan, M.R. and Visva-Bharati, 1994. Industrial pollution of irrigation water. In: *Affordable Water Supply and Sanitation*. 432-435.

Saravanmoorthy, M.D. and Ranjitha Kumari, B.D. 2007. Effect of textile waste water on morpho-physiology and yield on two varieties of peanut (*Arachis hypogea* L.). *Journal of Agricultural Technology*. 3 : 335–343.

Shafiq, M. and Iqbal, M.Z. 2005. The toxicity effects of heavy metals on germination and seedling growth of *Cassia siamea Lamark. J. New Seeds.* 7 : 95-105.

Sharma, R.K., Agrawal, M. and Marshall, F.M. 2007. Heavy metals contamination of soil and vegetables in suburban areas of Varanasi, India. *Ecotoxicology and Environmental Safety*. 66 : 258-266.

Singh, A. and Agrawal, M. 2010. Effects of municipal waste water irrigation on availability of heavy metals and morpho-physiological characteristics of *Beta vulgaris* L. *Journal of Environmental Biology*. 31(5) : 727-736.

Sofia Nawaz, Syeda Maria Ali and AzraYasmin 2006. Effect of Industrial Effluents on Seed Germination and Early Growth of *Cicer arientum, Joumal Biological Sciences*. 6 (1) : 49-54.

Thamizhiniyan, P., Sivakumar, P.V., Lenin, M. and Sivaraman M. 2009. Sugar mill effluent toxicity in crop plants. *Journal of Phytology*. 1 : 68–74.

Thawale, P. R., Juwarkar, A. A. and Singh, S. K. 2006. Resource conservation through land treatment of municipal wastewater. *Current Science.* 90 : 704-11.

WHO 2002. Water Pollutants: Biological Agents, Dissolved Chemicals, Non – Dissolved Chemicals, Sediments, Heat, *World Health Organization*, CEHA, Amman, Jordan.