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Effect of Textile Mill Effluent on Nodulation in *Pisum sativum* L.

Anita Gupta
Assistant Professor,
Deptt.of Botany,
Govt.College for Women,
Parade, Jammu,
J & K

Abstract

Treated and untreated effluents were collected from textile mill and analyzed for physio-chemical parameters using standard methods. An experiment was conducted to evaluate the impact of untreated textile dyes effluents i.e. red, green and yellow (25, 50, 75 and 100% concentrations) and treated effluents on nodulation in *Pisum sativum*. Similar experiment was conducted on the effect of different concentrations of three different chemicals (soda ash, sodium sulphide and caustic soda) used in processing in M/S Hindustan Electro Graphites (a unit of Bhilwara group). The study revealed that even the lower concentrations of the untreated effluent was inhibitory which suggest that waste water from textile mill could not be utilized as such for irrigation purposes. It can be utilized only after proper treatment and thus contribute, at least in part towards solving the problem of its disposal.

Keywords: Textile, Dye, Effluent, Nodulation, Leguminous Plants.

Introduction

The use of industrial waste water for irrigation of crops is a recent phenomenon and scientific community has focused its attention towards this only after 1940's, when the problem of fresh water pollution due to waste water disposal became acute. Since the population is increasing at an alarming rate which has put tremendous pressure on natural resources such as land and water (Naddafi et.al.,2005).To feed this growing population more and more land has to be put under cultivation which has in turn increased demand for irrigation water also (Barnett ,1999). Industrial waste water can help in solving this issue to some extent as in addition to water it has got considerable amount of nutrients also (Kanan et.al.,2005; Khan et.al.,2003).

Industrial effluents are those liquid wastes which are generated and disposed off at the end of the manufacturing processes These effluents are being pumped either aquatic ecosystems or spilling over the agricultural fields directly or through irrigation canals or even entering into ground water leading to deterioration of land, agricultural crops or the soil system.

Aim of the Study

The present investigation was conducted to evaluate the impact of textile effluent on nodulation in pea (*Pisum sativum* L.). Moreover, the aim of the present study was also to assess the possibility whether treated waste water from textile could safely be used to irrigate crop plants and solve the problem of effluent disposal in an eco-friendly manner.

Review of Literature

Industrial effluents are those liquid wastes which are generated and disposed off at the end of the manufacturing process. They vary with the type of industry, raw material used, the chemicals, dyes and the processes used. These effluents are loaded with essential nutrients and other organic matters. This drew the attention of many workers in effective utilization of waste water for improved crop production.

A detailed review of literature was performed to know the work done on similar or related aspects by several workers all over India. Sisodia and Bedi (1985) studied the impact of chemical industry effluents on seed germination and early growth performance of wheat. The impact of distillery effluents on seed germination, seedling growth and pigment content of *Cajanus cajan* was studied by Sahai et.al (1986). He observed that increasing concentrations of effluent induced a gradual decrease in germination percentage and speed of germination index. The pure effluent was lethal. Dayama (1987) while working on influence of dyeing and textile water pollution on nodulation and germination of gram (Cicer arietinum) observed decreasing trend with increasing concentrations.Vijaykumari

et.al. (1993) reported the promotive effect of soap factory effluents on Finger millet and Pearl millet when used after dilution. Mala and Babu (2005) observed an increase in germination and seedling growth in plants treated with textile effluent. Similar results were also observed by Rajeswari et.al (2005), while studying impact of dye house effluent on plant growth and soil characteristics. An increase in germination percentage and seedling growth was observed in gram when irrigated with fertilizer factory effluents (Singh et.al., 2006). The higher concentrations were found to be detrimental. Mehdi et.al (2005) studied the effect of lime sludge waste of paper mill on rice and observed an increase in growth and yield in lower concentrations of the effluent.

Materials and Methods

The effluent was collected in clean plastic container at the point of disposal outlet from Hidustan Electro Graphite (A unit of Bhilwara guoup) located at Baribrahmana Jammu. Immediately after collection, the effluent was brought to laboratory.The physicochemical characteristics of various parameters i.e. P_H, electrical conductivity, total suspended solids, total dissolved solids, total hardness and alkalinity were estimated as per methods of APHA (1985).

The soil sample used for experiment was collected from Botanical garden Jammu University. It was then spread out thinly on the floor for drying.

Seeds of pea were procured from Directorate of Agriculture Jammu. The seeds were sown in polythene bags.

The textile mill effluent was considered as 100% concentration. From effluent of this 100% conc. 25%, 50%, 75% level of effluent conc.were prepared using tap water for three different dyes. 10 seeds were sown in each bag. 41 sets of polythene bags were made. 12 sets for different conc.of untreated effluents of three dyes viz-Red, Green and Yellow ,1 set for treated effluent , 1 set for control and 27 sets for different conc. of three chemicals. 10 seeds were sown in each bag.The number of nodules was recorded at the interval of 15 days in different conc. of untreated effluent, treated effluent, control and different conc. of three different chemicals.

Results and Discussions

The physico-chemical characteristics of textile mill effluent are presented in Table 1and Table 2. On visual observation, the color of the effluent was found to be dark.The color of effluent is usually estimated by visual method and depends upon the chemicals or the raw material used in processing (Agarwal, 2005). The mean value of P_H was 7.5 before treatment and 7.7 after treatment. The effluent was slightly alkaline. Alkalinity of the water is the capacity to neutralize strong acids and is characterized by presence of (OH^-) ions (Sexana, 1954). The value of electrical conductivity, suspended solids, alkalinity, biological oxygen demand and chemical oxygen demand in the untreated effluent were very high in comparisons to IS prescribed limit (IS: 2296 1982). However in treated effluent these values were within permissible limits. The mean value of electric conductivity was 4.26M mhos. The ability to transmit electric current depends upon the concentration of charged ions present in water (Trivedy and Goel,1986). The mean value of hardness was 472 mg/l in untreated effluent. In treated effluent the mean value of hardness was 225 mg/l. These values are within permissible limits, so it has no adverse effect. The total hardness of water is the sum of alkaline cations psesent in it. Hardness is primarily due to the presence of carbonates and bicarbonates (Trivedy and Goel 1986).

Table 1

Physico-Chemical Characteristics of Effluent before and after Treatment

Parameters	Value Before Treatment	Value After Treatment	Permissible Limits (IS)
Color	Dark	Clear	-
Temperature	35-45˚c	25˚c	-
PH	7.5	7.1	-
Alkalinity (as caco3)	725 mg/l	-	200 mg/l
Hardness	472mg/l	225mg/l	600mg/l
TSS	1850 mg/l	25 mg/l	200 mg/l
TDS	-	0.5 mg/l	1000 mg/l
COD	530mg/l	228mg/l	350mg/l
BOD	205mg/l	28mg/l	100mg/l
Oil and grease	-	1 mg/l	-

Table 2

Physico-Chemical Characteristics of Effluent with Dyes

Parameters	Red dye	Green dye	Yellow dye
Color	Dark	Dark	Dark
P_H	10.24	10.59	11.32
Temperature	40˚c	38˚c	35˚c
TSS	Neglisible	50mg/l	100 mg/l
TDS	54.8 mg/l	43.7mg/l	23.9 mg/l

Table-3

Average no. of nodules of plants in different concentrations of effluents with dyes ,treated effluent and control from 30 to 90 days

Conc. (%) Dyes	No. of Nodules				
	30 Days	45 Days	60 Days	75 Days	90 Days
RD 25%	-	-	-	-	-
RD 50%	-	-	-	-	-
RD 75%	-	-	-	-	-
RD 100%	-	-	-	-	-
GD 25%	-	-	-	-	-
GD 50%	-	-	-	-	-
GD 75%	-	-	-	-	-
GD 100%	-	-	-	-	-
YD 25%	-	-	-	-	-
YD 50%	-	-	-	-	-
YD 75%	-	-	-	-	-
YD 100%	-	-	-	-	-
TE	-	2	2	5	4
Control	3	4	6	9	12

RD = Red Dye, GD = Green Dye, YD =Yellow Dye, TE= Treated Effluent, C= Control .

Table-4
Average No. of Nodules of Plants in Different Concentrations of Different Chemicals From 30 to 90 Days.

Conc. (ppm)	No. of Nodules														
	30 Days			45Days			60 Days			75 Days			90 Days		
	SA	SS	CS	SA	SS	CS	SA	SS	CS	SA	SS	CS	SA	SS	CS
250ppm	-	-	-	6	1	5	5	2	7	6	4	6	9	7	12
500ppm	-	-	-	3	1	-	4	2	3	5	3	5	5	4	10
750ppm	1	-	1	1	-	1	5	1	3	5	2	8	6	3	9
1000ppm	-	-	-	-	1	1	3	2	4	7	2	5	4	4	9
1500ppm	-	-	1	-	-	-	2	3	5	3	5	2	7	2	6
2000ppm	-	-	-	4	-	3	2	2	2	2	2	2	3	5	1
3000ppm	1	-	-	-	-	-	-	-	1	-	1	-	1	-	3
4000ppm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5000ppm	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-

The number of nodules of plants in different concentrations of different dyes, treated effluent and control from 30 to 90 days has been given in Table -3 and represented graphically in Fig.1

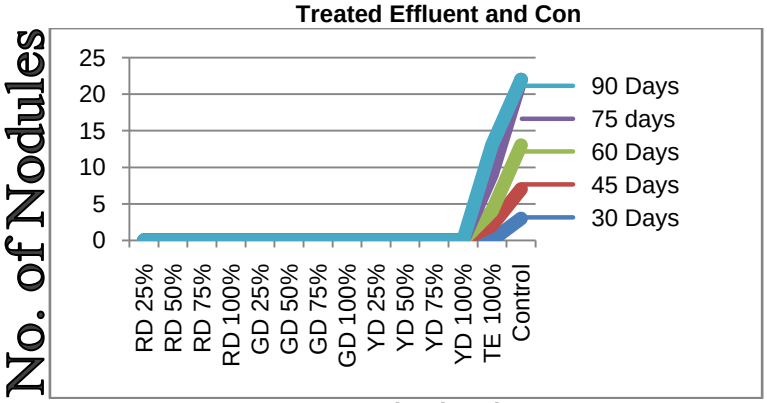
No nodules were recorded in plants treated with different dyes. In the experiment with treated effluent the highest number of nodules was recorded (5) at 75 days and in control the highest number of nodules was recorded as 12 at 90 days.

The number of nodules in different concentrations of three different chemicals used in processing of fabric in textile mill are presented in Table -4 and represented graphically in Fig. 2 for soda ash, Fig. 3 for sodium sulphide and Fig. 4 for caustic soda .The results revealed that the average number of nodules was highest (12) in caustic soda followed by soda ash (09) and in sodium sulphide (07) in 250 ppm concentration at 90 days. The lowest number of nodules was recorded in soda ash (01) in 3000 ppm and caustic soda (01) in 2000ppm concentration at 90 days and in sodium sulphide it was (02) in 1500ppm concentration at 90 days.

The study revealed that there was no nodules formation in effluent treated plants. This might be due to presence of growth inhibitory substances in the effluent, which interfere with nodule formation. Even the lower concentrations of untreated effluent inhibited nodule formation. The reason might be the presence of huge amount of total suspended solids in the effluents. Total suspended solids in the effluent of textile mill were 1850 mg/l ,which caused high osmotic pressure in soil solution. It might be major cause for rapid deterioration of soil properties that regulate the flow dynamics of salt, storage and distribution of nutrients and water uptake by plant roots. The soil productivity is decreased due to reduced nutrients availability and poor plant growth (Prashanti *et.al.,* 2001) . Moreover high amount of suspended solids have the tendency to clog sprinkler nozzles and soil pores leading to anaerobic condition in root zone (Raghuveer, 1994). The aerobic conditions necessary for soil microbial processes are inhibited which interfere with the growth of secondary and tertiary roots. It is on these roots that the root nodules are present,which help in fixation of atmospheric nitrogen. However the plants irrigated with treated effluent (100%), showed nodulation but the number of nodule was less as compared to control.

The data indicates that for nodule production in this crop the three chemicals used behaved differently. The number of nodule production was more in plants treated with caustic soda followed by soda ash. In plants treated with sodium sulphide the number of nodules was less as compared to other two chemicals. But all the three chemicals showed decreasing trend with increasing concentrations. The findings were very much in accordance with Rajeswari (2003) and Malla and Mohanty (2005).

Fig. 1 Dyes, Treated Effluent and Control
Number of Nodules in Different Conc. of Effluents with Treated Effluent and Con



Concentration (ppm)
RD=Red Dye, GD=Green Dye,YD=Yellow Dye

Fig.2 Soda Ash
Number of Nodules in Different Conc. of Soda Ash

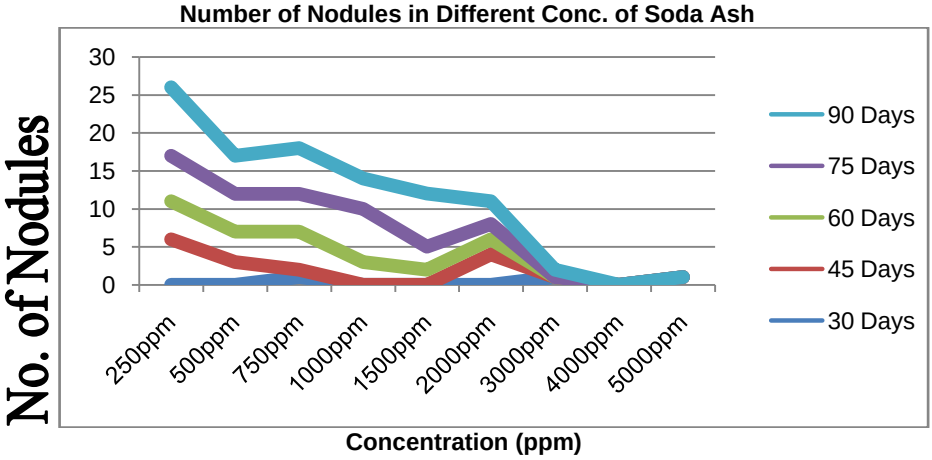


Fig. 3 Sodium Sulphide
Number of Nodules in Different Conc. of Sodium Sulphide

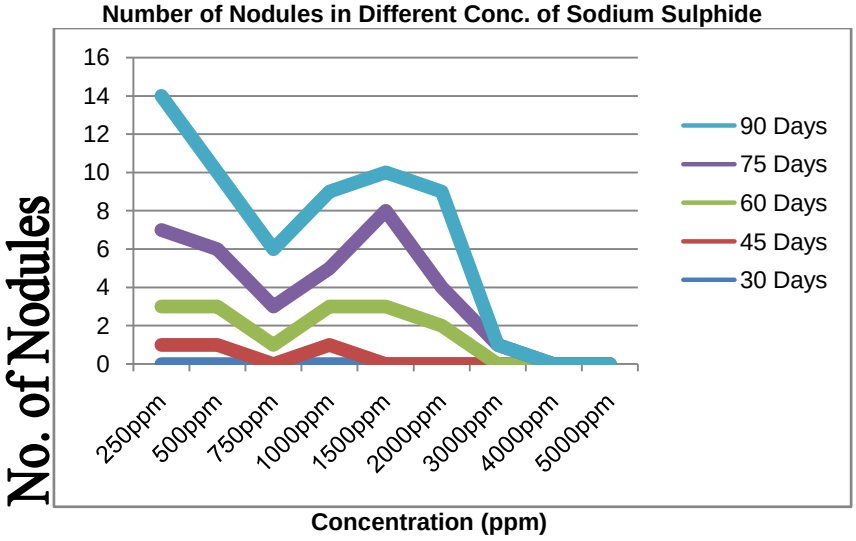
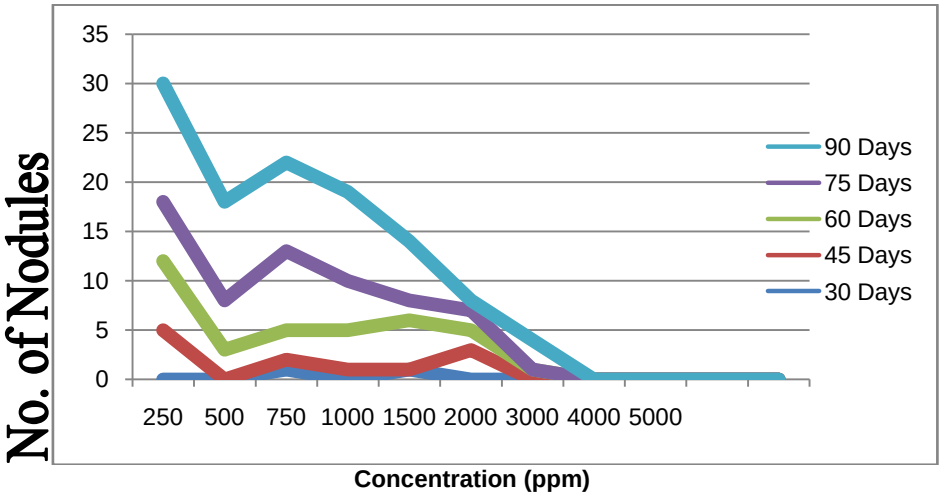


Fig. 4 Caustic Soda
Number of Nodules in Different Conc. of Caustic Soda



Conclusion

Textile dye untreated effluent significantly influence nodulation in Pisum sativum due heavy loads of chemicals .Even the treated effluent is harmful to the crop since it also contains considerable amount toxic elements which caused reduction in nodule production.It is recommended that the effluents should not be released into the receiving

waters without treatment and the treatment plant should be based on modern technology to further reduce the toxic chemicals, whether into the receiving waters or on the soil, so that it does not produce harmful results and could be safely and efficiently reused for atleast for irrigation purposes for the crops.

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