RESEARCH PAPER | Botany | Volume : 3 | Issue : 11 | Nov 2013 | ISSN - 2249-555X

Effect of Raw and Treated Dye Industrial Effluent on Pulse Crop

KEYWORDS: block gram, coir pith, effluents, vermicompost, dye industry

D. Ravi	S. Rajamohan
Bioprocess lab, PG & Research Department of Botany, Government Arts College, Coimbatore – 641018, Tamilnadu	Bioprocess lab, PG & Research Department of Botany, Government Arts College, Coimbatore – 641018, Tamilnadu
R. Parthasarathy	**V. Vijayabharathi**
Bioprocess lab, PG & Research Department of Botany, Government Arts College	Bioprocess lab, PG & Research Department of Botany, Government Arts College, Coimbatore – 641018, Tamilnadu

ABSTRACT *Textile dyeing industry is one of the major water consuming and high polluting industries in India. Effluent in higher concentrations affect the soil and causes heavy damage to crops growth conditions. Recent awareness and growing global concern for deterioration in the quality of environment has induced great interest in the identifying the various types of pollutants and the effect on living organisms. The main objective of this study is solving the problem occurring by textile & dyeing industrial waste by using the agricultural important crops. The present study focused on find the Physico-chemical analysis of textile dyeing industry effluent, suitable black gram variety for tolerance to textile dye industry effluent through germination studies and identification of biochemical concentrations in treated black gram crop. Germination studies were carried out for various black gram varieties CO.2, CO.5, CO.593, ADT.5, LBG.20, T.9, TMV.1, TU.942, and VBG.23 and Vamban.2 Physico chemical characters of textile dyeing industry effluents were studied. Low concentration of the dye industry waste at 10% concentration proven that it is a growth promoting substances were present in the effluent. In the present study shows the root length, shoot length, total leaf area, dry weight and yield of black gram reduced due to sludge application. It is concluded that the textile dyeing industry effluent in higher concentration is toxic to crop plants. i.e lower concentration of textile dyeing industry enhances the germination and seedling growth. The lower concentration of effluent can be used for irrigation after proper treatment. Toxic effluents should be treated to reduce the toxic content from the sludge and utilized for the cultivation of crops with various combinations of soil, vermicompost, Bio-fertilizer, coir waste and cow dung etc.*

Introduction:

Environment may be defined as total planetary inheritance and totality of all resources. It consists of air, food and sunlight which are the basic needs of all living beings and plant life to carry on their life function (Sharma, 2001).

Pollution is an undesirable change in the physical – chemical or biological characteristic of our air, land and water that may be harmfully affect human on life (Odum, 1960). The unplanned rapid industrial growth is the main cause for the environmental pollution. Each industry is associated with an emission of many pollutants. The industrial pollutants caused the alteration in Physico – chemical and biological properties of the environment.

Industrial effluents discharged into water nearby water bodies by make them toxic by discharging of suspended solids contain toxic chemicals, oils, greases dyes, suspended solids, radioactive wastes and thermal pollutants from various industries. The pollutants vary in their concentrations and it depends up on raw materials used and the quantity of water let in.

Textile dyeing industry is one of the major water consuming and high polluting industries in India. Coimbatore District called as the textile city and cotton city since it is covered by many small scale textile dyeing units. It plays an important role in creating water pollution by discharging partially treated or untreated effluent into near by water bodies.

In Tirupur industrial area, several dyeing and textile industries combine together and install their common effluent treatment plant (CETP). There are more than 15 CETP in and around Tirupur. Each plant collect the effluents from 10 – 20 textile dyeing units and they are given primary treatment (screening for the removal of solid materials by mechanical), and secondary treatment (Coagulation sedimentation of solids by adding chemicals). As a result of coagulation treatment, a large amount of solids settle in the drying tanks, called sludge. The disposal of sludge is a major problem in textile and dyeing industrial area of Tirupur. The present study was undertaken to quantify the presence of different pollutants in effluent and also in sludge and to find the possibilities of utilization of this effluent and sludge for crop cultivation.

A variety of new dyes such as acid dye, mordant dyes, disperse dyes, sulphur dyes, cationic dyes and reactive dyes are introduced (Hemalatha et al., 1997). In dyeing industry these dyes are mainly used to dye the fabrics. A small percentage of the dye is used to color foods, drugs and cosmetics. During the dyeing process, the dyeing industries need more water and they discharge their coloured wastewater into the river or near by water bodies. Among the different toxic compounds present in the wastewaters, the coloured organic compounds constitute only a minor fraction. Though meager in quantity, they make the wastewater aesthetically unacceptable. The waste water is considered as a great boon in the present situation to fulfill the water scarcity. Recycling of waste for irrigational purposes not only solve the disposal problem but also serve as an additional source of liquid fertilizer needed for the growing crops (Noorjahan et al., 2003). The effluents contain inorganic and in less concentration it is enhancing the growth and yield of crops. There are several reports of their beneficial influence on crop plants. But the effluents affect the soil and cause heavy damage to crops

Volume : 3 | Issue : 11 | Nov 2013 | ISSN - 2249-555X

(Sundaramoorthy and Kunjithapatham, 2000). Recent awareness and growing global concern for deterioration in the quality of environment has induced great interest in the identification of pollutants and their effects on plants, animals and human beings.

Materials and Methods:
Germination studies were carried out in the ecology laboratory, Department of Botany, Government Arts College, Coimbatore. The pot culture experiments were conducted in the Green house at Department of Botany, Government Arts College, Coimbatore, Tamilnadu.

Seed Materials:
The seeds of ten varieties of blackgram (*vigna munga (L)* namely (ADT.5, CO.2, CO.5, CO.593, LBG.20, T.9, TMV.1, TU.942, Vamban.2 and VBG.23) were obtained from oil seeds regional research station of Tamilnadu Agricultural, Virudhachalam, Cuddalore District, Tamilnadu. The seeds with uniform size and color were chosen for experimental purpose. They were used for experimental studies.

Effluent samples:
Textile dyeing industry effluent was collected in plastic containers from the outlet of Andipalayam Common Effluent Treatment Plant (ACETP), Andipalayam, Tirupur District, Tamilnadu. The effluent was diluted with distilled water to get following concentrations (5, 10, 25, 50, 75 per cent) were prepared and used for experimental studies.

Analysis of effluent samples:
The effluent sample was analyzed for their Physico – chemical properties by following the routine standard methods mentioned in American Public Health Association (APHA, 1998).

Morphological parameters:
The various morphological growth parameters such as shoot length, root length and total lead area were recorded once in 15 days (15, 30, 45 & 60 days).

Total leaf area:
Leaf area was calculated as described by Yoshida et al., (1972). Total leaf area for each plant was calculated by adding the area of all the leaves of plant. Leaf area was calculated by using formula

Leaf area (cm^2) = L x B x K
Where
Leaf area = length x width x K
K = Kemp's constant 0.66

Yield Parameters:
Five plants from each and every treatment including control were taken into consideration. The yield parameters such as dry weight of the fruits/plant were observed and recorded at the time of harvest.

Results:
Physico chemical characters of textile dyeing industry effluent:
The Physico chemical properties of textile dyeing industry effluent are shown in

Table – 1: Physico – Chemical Characteristics of textile dyeing Industry Effluent

Parameters	
Colour	Bluish
pH	6.71
Electrical Conductivity	10920 Mm ohms
Temperature	29° C
Suspended solids	300
Total solids	9745
Biological Oxygen Demand	54.4
Chemical Oxygen Demand	64.0
Carbonate alkalinity	20
Bicarbonate alkalinity	280
Sodium	850
Chloride	1760
Calcium	169.60
Magnesium	199.68
Potassium	62.5

The textile dyeing industry effluent was bluish in colour. It was acidic in nature with a pH of 6.71. It contained a considerable amount of suspended solids (300 mg/l), total solids (9745 mg/l), bicarbonate (280 mg/l), and carbonate alkalinity (20 mg/l). The biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) of the effluent were found (54.4 mg/l) and (64.00 mg/l) respectively. It also contains other elements such as chloride (1760 mg/l), calcium (169.60 mg/l) magnesium (199.68 mg/l) and potassium (62.5 mg/l).

Root Length:
The root length of blackgram growth in textile dyeing industry sludge mixed with various amendments is shown in

Table – 2: Root length of black gram (*Vigna munga L. Hepper*) grown under textile dyeing industry sludge with various soil combination (cm/plant)

Various soil combination of sludge	Age of the plants (Days after sowing)			
	15	30	45	60
Sludge + garden soil	6.45	10.24	16.28	18.84
Sludge + garden soil + coirwaste	7.15	12.68	19.46	21.65
Sludge + garden soil + vermicompost	7.00	12.45	19.14	21.14
Sludge + garden soil + Biofertilizer	6.86	11.36	18.64	20.46
Sludge + garden soil + cow dung	7.17	12.44	19.10	21.45
Sludge	1.88	3.94	4.53	54.44

The root length increased with the age of the plant. The root length showed an increasing trend. The highest root length (7.15, 12.68, 19.46 and 21.65 cm/plant at 15, 30, 45 and 60 days) was recorded in the plants grown in sludge mixed with coirwaste + garden soil. The lowest root length (1.88, 3.94, 4.53 and 5.44 cm/plant) at 15, 30, 45 and 60 days) was recorded at 100 % sludge.

Shoot Length:
The shoot length of black gram grown in dyeing industry sludge is shown in

Table – 3: Shoot length of black gram (*Vigna munga L. Hepper*) grown under textile dyeing sludge with various soil combination (cm/plant)

Various soil combination of sludge	Age of the plants (Days after sowing)			
	15	30	45	60
Sludge + garden soil	15.36	24.40	28.42	30.68
Sludge + garden soil + coirwaste	18.45	26.56	30.35	33.45
Sludge + garden soil + vermicompost	17.24	25.40	29.65	32.18
Sludge + garden soil + Biofertilizer	16.35	24.25	28.78	31.42
Sludge + garden soil + cow dung	17.15	25.45	29.85	32.14
Sludge	4.65	5.15	7.00	9.14

The highest shoot length (18.45, 26.56, 30.35 and 33.45 cm/plant for 15, 30, 45 and 60 DAS) was recorded in sludge mixed with coir waste and garden soil. The lowest shoot length (4.65, 5.15, 7.00 and 15.30, 45 and 60 days) was recorded in black gram grown in 100 percent dyeing industry sludge.

Volume : 3 | Issue : 11 | Nov 2013 | ISSN - 2249-555X

Total leaf area:
The total leaf area of the plants grown in sludge mixed with various soil amendments are shown in

Table – 4: Total leaf area of black gram (*Vigna munga L. Hepper*) grown under textile dyeing sludge with various soil combination (cm²/plant)

Various soil combination of sludge	Age of the plants (Days after sowing)			
	15	30	45	60
Sludge + garden soil	1.162	8.164	15.163	14.186
Sludge + garden soil + coirwaste	2.186	10.920	17.186	16.68
Sludge + garden soil + vermicompost	2.120	9.840	16.240	15.435
Sludge + garden soil + Biofertilizer	1.940	8.940	15.810	14.560
Sludge + garden soil + cow dung	2.120	9.210	16.410	15.350
Sludge	0.110	2.420	3.350	2.210

The total leaf area increased up to 45 days of the plants and it decreased thereafter. The highest total leaf area (2.186, 10.920, 17.186 and 16.63 sq.cm/plants at 15, 30, 45 and 60 days respectively) was recorded in the plants grown in sludge mixed with coir waste and garden soil. The lowest total leaf area (0.11., 2.420, 3.350 and 2.210 sq.cm/plant at 15, 30, 45 and 60 days respectively) was recorded in textile dye industry sludge.

Dry weight:
The dry weight of blackgram under mixed with textile dyeing industry sludge is given in

Table – 5: Dry weight of black gram (*Vigna munga L. Hepper*) grown under textile dyeing sludge with various soil combination (g/plant)

Various soil combination of sludge	Age of the plants (Days after sowing)			
	15	30	45	60
Sludge + garden soil	0.632	0.986	1.314	1.163
Sludge + garden soil + coirwaste	0.914	1.112	1.536	1.324
Sludge + garden soil + vermicompost	0.845	1.060	1.340	1.240
Sludge + garden soil + Biofertilizer	0.760	0.995	1.326	1.175
Sludge + garden soil + cow dung	0.865	1.110	1.400	1.275
Sludge	0.140	0.255	0.540	0.345

The dry weight increased up to 45 days and decreased thereafter. The plants grown in sludge mixed with coirwaste and garden soil showed more growth than other treatments. The highest plants dry weight (0.914, 1.112, 1.536 and 1.324 g/plant 15, 30, 45 and 60 days respectively was recorded in sludge mixed with coirwaste and garden soil. The lowest dry weight of black gram (0.140, 0.255, 0.540 and 0.345 g/plant) for 15, 30, 45 and 60 days respectively was recorded at 100 per cent sludge.

Yield of parameters:
The morphological and yield parameters of black gram (at the time of harvest) grown in textile and dyeing industry sludge are presented in

Table – 6: Yield parameters of black gram (*Vigna munga L. Hepper*) grown under textile dyeing sludge with various soil combination (cm/plant)

Various soil combination of sludge	Plant height (cm/plant)	Leaf Area (cm²/plant)	Dry Weight (cm/plant)	Yeild (g/plant)
Sludge + garden soil	42.25	24.45	18.340	29.542
Sludge + garden soil + coirwaste	46.32	29.25	21.360	33.625
Sludge + garden soil + vermicompost	44.15	27.40	20.460	32.410
Sludge + garden soil + Biofertilizer	43.15	25.65	19.685	30.245
Sludge + garden soil + cow dung	45.10	27.65	20.435	32.240
Sludge	15.45	03.15	0.425	06.365

The plant grown in sludge mixed with garden soil and coirwaste showed the higher plant growth (46.32 cm/plant), leaf are (29.25 sq.cm/plant), dry weight (21.36 g/plant) and yield (33.625 g/plant). The lowest value for plant height (15.45 cm/plant) leaf area (3.15 sq.cm/plant) dry weight (0.425 g/plant) and yield (6.365 g/plant) was observed in the plants grown in sludge.

Discussion:
Industrialization is linked to economic growth and human progress. Increasing technological development and multiplication of numerous products to provide basic necessities, facilities, amenities, luxuries and comforts for the explosively growing population. It is emphasized that increasing in the number of industries leads to deterioration of environmental quality and subsequently to healthy hazards of man and animal. The rapid unplanned industrial progress had added to the problem of pollution to the environment. Industrial pollutants are known to bring changes in the abiotic and biotic components of the ecosystem (Noorjahan et al., 2003).

The effluent is collected from outlet of Common Effluent Treatment Plat (ACEPTP), at Andipalayam, Tiruppur, Coimbatore District, Tamilnadu. They were analyzed to know their Physico chemical properties. The main polluting constituents of textile dyeing industry effluents are high solids, phosphorous, nitrogen and sodium associated with chloride.

Industries produce various environmental problems in and around the factory hence it is necessary to understand the impact of these industrial effluents on the environment. The industrial effluent generally contain various contaminates in the form of organic and inorganic chemical. Presence of these chemicals in large quantities in the effluent imparts detrimental effects on plant development including germination and seedling growth (Baruah and Das., 1998). The concentrations of various forms of pollutants and high BOD and COD may contribute the toxicity of the effluent.

In the present study the reduction in root length, shoot length, dry weight and yield parameters of black gram seedlings grown in textile dye industrial sludge. Similar type of tolerance studies were carried out by Appala raju (1986) on seven varieties of finger millet to factory effluent, Sing et al., (1985) on three varieties of rice for sugar and distillery effluent and Nirmala Rani and Janardhanan, (1988) on five varieties of maize for viscose and chemical factory effluent treatment. The varietal screening of groundnut for tolerance to fertilizer factory effluent (Sundaramoorthy, 1995). Paper mill effluent (Sundaramoorthy and Kunjithapatham, 2000) tannery effluent (Sundaramoorthy and Lakshmi, 2000) and sugar mill effluent (Ezhumalai, 2002 and Sundari, 2003) were reported. Simarilalrly, the screening of paddy cultivars for tolerance to tannery effluent (Lakshmi and Sundaramoorthy, 2003) and sugar mill effluent (Sundaramoorthy et al., 2003) was reported.

In the present study, the shoot length, root length, total leaf area, dry weight and yield of black gram reduced due to sludge application. It was reported that vegetables and crops are more susceptible to various soil pollutants by the plants and inhibit their growth (Dutta and Boissys, 1999), the pres-

Volume : 3 | Issue : 11 | Nov 2013 | ISSN - 2249-555X

ence of heavy metals and higher quality of other elements inhibit their growth and yield of plants. The heavy metals are highly affecting the levels of protochlorophyll and carotenoid content (Hemalatha et al., 1997).

It is concluded that the textile dyeing industry effluent is toxic to crop plants. The treated and diluted effluent can be used for irrigation for getting higher yield. Through the solid waste contain heavy metals; it should be treated amended till the toxic level to be below to the accepted level for plants. Hence, the growth of tree species is not much affected. Considering the fact of environmental pollution by dumping of solid waste, application to tree species at a suitable is a good alternative which favors safe disposal and beneficial reuse.

ACKNOWLEDGEMENT:
The author and Co-authors have a great sense of gratitude to DST (TSD), Government of India, New Delhi for carrying out this kind of effective research in Government arts college, Coimbatore.

REFERENCE

APHA, 1998, Standard methods for the examination of water and wastewater (20th edition), Washington. D.C. American Public Health Association. | Appala raju. P, 1986. Alum factory effluent on soil characters and plant life with special reference to finger millet. Ph.D. Thesis, Andhra University, Waltair. | Baruah, B.K. and M. Das., 1998. Study on the effect of paper mill effluent on Physico – chemical characteristics of soil. J. Nature Conser., 10 (1): 101 – 106. | Behera, B.K. and B.N. Misra, 1983. Analysis of the effect of industrial effluent on pigments, proteins, nucleic acid and 2, 6 – dichlorophenol indophenol hill reaction of rice seedlings. Environ. Res., 31: 381 – 318. | Dutta, S.K and C.I. Boissys, 1999. Effect of paper mill effluent on growth and yield of N.P.K. contents of transplanted rice (Oryza sativa L. var. Mahsuri). J. Environ. Biol., 20 (1): 29 – 32. | Ezhumalai, D. 2002. Screening of blackgram varieties for tolerance to sugar mill effluent treatment. M.Phill. Thesis, Annamalai University, Annamalai Nagar. | Hemalatha, S., A. Anburas and K. Francis, 1997. Effect of heavy metals on certain bio – chemical constituents and nitrate reductase activity in Oriza sativa L. seedlings. J. Environ. Biol. 18 (3): 313 – 319. | Lakshmi and P. Sundaramoorthy, 2003. Effect of chromium on germination and biochemical changes in blackgram J. Ecobiol. 15 (1). 07 – 11. | Madhappan. K, 1993. Impact of tannery effluent on seed germination, morphological characters and pigment concentration of Phaseolus mungo L. and Phaseolus aureus L. Poll. Res., 12 (3): 159 – 163. | Nag, P.A.K. Pabu and Mukherji, 1981. Heavy metal effects in plant tissue involving chlorophyll, chlorophyllase, hill reaction activity and gel electrophoretic patterns of soluble protein. Indian J. Exp. Biol. 19. 702 – 706. | Nirmala Rani, J. and K. Janardhanan, 1988. Effect of South India Viscose factory effluent on seed germination, seedling growth and chloroplast pigments contents in fire varieties of maize (Zea mays L.). Madras Agric. J,. 75 (1 – 2): 41 – 47. | Noorjahan C.M, S. Dawood Sharief and D. Nausheen, 2003. Impact of dyeing on biochemical constituents of fish Oreochromis mossambica. J. Ecotoxical. Environ. Moni. 13 (3): 227 – 231. | Odum, E.P. 1960. Organic mater production and turnover in old field secession. J. Ecol. 41: 34 – 39. | Sharma, B.K. 2001. In An Introduction to Envitonmental Pollution. Goel Publishing House, Meerut, India. | Singh, D.K., D. Kumar and V.P. Sing. 1985. Studies on pollutional effects of sugar mill and distillery effluent on seed germination and seedling growth of three varieties of rice. J. Environ. Biol., 6 (1): 31 – 32. | Sundaramoorthy, P. and J. Kunjithapatham, 2000. Effect of paper mill effluent on seed germination and seedling growth of six varieties of groundnut (Arachis hypogaea L.). J. Ecotoxicol. Monit., 10 (1): 53 – 57 | Sundaramoorthy, P.1995. Ecophysiological studies on the effect of Neyveli Lignite Corporation Fertilizer Factory effluent on growth and yield of groundnut (Arachis hypogaea). Ph.D Thesis, Annamalai University, Tamilnadu. | Sundaramoorthy. P, and Lakshmanachary, 2003. Use of raw and treated industrial effluent for the cultivation of groundnut. In status of Indian Environment (Ed. Abbashi) Discovery Publication, New Delhi. | Sundaramoorthy. P. and S. Lakshmi, 2000. Toxicity effect of tannery effluent on seed germination and seedling growth of six varieties of groundnut (Arachis hypogaea L.) and paddy (Oryza sativa L.). Poll. Res., 21 (2): 452 – 458. | Sundari, 2003. Effect of pre – sowing seed hardening treatment on groundnut (Arachis hypogaea L.) under the different concentration of sugar mill effluent, M.Phill thesis, Annamalai University. |