INTERNATIONAL JOURNAL OF PROCESSING AND POST HARVEST TECHNOLOGY (December, 2010); 1 (2) : 107-110

RESEARCH PAPER

Received : Nov., 2010; Accepted : Dec., 2010

Impact of biologically treated dye factory effluent and the efficacy of biofertilizer amendment on seed germinability, biochemistry and yield of *Vigna mungo* (L.) Hepper

I. JAYASHREE, M. RAJESWARI AND S. SHARMILA

ABSTRACT

The study reported the effect of short-term effluent irrigation along with bioferitilizer (Rhizobia + Phosphobacteria) amendments on seed germination, biochemistry and yield of black gram under pot condition. Higher concentrations of the raw effluent were deleterious to the plant. However, dilution of the effluent, irrigation by treated effluents (biologically and chemically treated effluents from dye factory) and soil incorporation of biofertilizers gave better results comparable with that of the control.

KEY WORDS : Dye effluent, Biofertilizer, Biological treatment, Biochemical constituents

Jayashree, I., Rajeswari, M. and Sharmila, S. (2010). Impact of biologically treated dye factory effluent and the efficacy of biofertilizer amendment on seed germinability, biochemistry and yield of *Vigna mungo* (L.) Hepper, *Internat. J. Proc. & Post Harvest Technol.,* **1** (2) : 107-110.

INTRODUCTION

Rapid industrialization has led to enormous amount of discharge of industrial wastes leading to heavy pollution of fresh water resources. The dyeing industry is one of the major industries in our country. The disposal of dyeing wastes after proper dilution serves as a potential source of fertilizer for agricultural use (Sujatha and Gupta, 1996; Subramani *et al.*, 1998). Effluents can be treated at the source itself through physical, chemical and biological processes. Among them, biological treatment methods are more effective and ecofriendly than chemical methods. Aquatic weeds like waterhyacinths are capable of absorbing, metabolizing and concentrating nutrients and chemical pollutants from polluted water body (Wolverton, 1975; Cornwell *et al.*, 1977 and Gersberg *et al.*, 1984). The response of various crops to the combined effect of effluent and different biofertilizers has been well documented (Natarajan and Oblisami, 1980; Subrahmanyam *et al.,* 1984). Therefore, a thorough investigation of the effluents on the crop and the ameliorative effect of biofertilizers and water weeds on the effluent characteristics is essential before it is implemented in agriculture.

Correspondence to:
I. JAYASHREE, P.G. and Research Department of Botany, Vellalar College for Women, ERODE (T.N.) INDIA

Authors' affiliations:
M. RAJESWARI AND S. SHARMILA, P.G. and Research, Department of Botany, Vellalar College for Women, ERODE (T.N.) INDIA

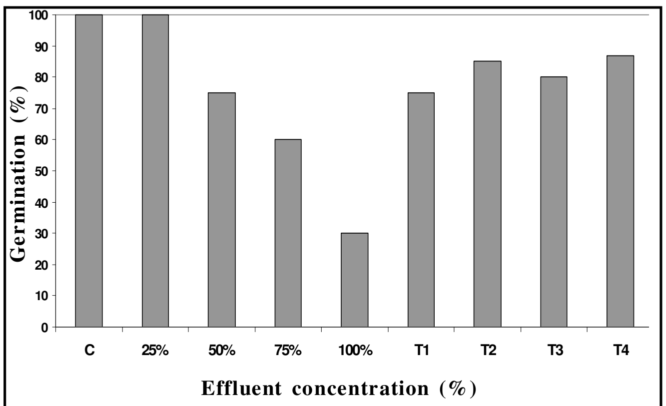
MATERIALS AND METHODS

The raw and treated effluent (effluent treated in dye factory by chemical process) samples were collected from a medium sized dye factory. Some quantity of the effluent was taken in plastic containers and treated biologically using *Eichhornia crassipes*. The plastic containers were kept in the laboratory at $30^0 \pm 2^0$C room temperature for 8 days (retention period). After the retention period 1 litre of this biologically treated effluent (T_1) was used for irrigating the crops. *Vigna mungo* (L.) Hepper was used as the test plant. It was grown in pots filled with field soil. In another experimental set, the soil in some of the pots was amended with biofertilizer (Rhizobia + Phosphobacteria) in the ratio of 5:1 (soil:biofertilizer) and the plants were irrigated using treated effluents – biologically treated effluent (T_2) and chemically treated effluent (T_4). The plants were irrigated with different concentrations (25%, 50%, 75% and 100%) of raw effluent, biologically treated effluent (T_1) and factory treated effluent (T_3) at fortnightly interval. Tap water was used for intermittent watering whenever necessary. Control was maintained using tap water. No pesticide was applied to the plants during the course of study. The results were observed at four age levels (20,40,60 and 80-old days). Seed germination was studied using sand culture method.

The biochemical constituents such as Chlorophyll (Arnon, 1949), Protein (Lowry *et al.*, 1951) and Soluble carbohydrates (Clegg, 1956) were studied. The yield was also studied in terms of pod length and number of seeds per pod.

● RESULTS AND DISCUSSION ●

The test plant *Vigna mungo* showed 100% seed germination in control water and 25% effluent dilution as depicted in Fig 1. Higher concentrations of the effluent (75% and 100%) had a detrimental effect on germination. However, the treated [biologically (T_1) and factory (T_3)] effluents had no adverse effect on seed germination. The high quantity of total and suspended solids in the raw effluent seems to be responsible for germination inhibition as they disturb the osmotic relation of the seed and water. So the germinated seeds get low amount of oxygen in the form of DO, then restricting their energy supply through aerobic respiration (Maguire, 1973; Mhatre and Chaphekar, 1982).



T_1 = Biologially treated effluent
T_2 = Biologically treated effluent + vermicompost
T_3 = Factory treated effluent
T_4 = Factory treated effluent + vermicompost

Fig 1 : Effect of various concentrations of raw dye factory effluent, biologically treated effluent and treated effluent from dye factory in combination with vermicompost on the seed germination of *Vigna mungo* (L.) Hepper

The biochemical constituents such as chlorophyll, protein and soluble carbohydrates were estimated in the fourth unfolded leaves of *V. mungo* and presented in Table 1. Maximum chlorophyll content was observed in 40-day-old plants. Highest content of chlorophyll was recorded in plants irrigated with factory treated dye effluent with

Table 1 : Effect of various concentrations of raw dye factory effluent, biologically treated effluent and treated effluent from dye factory in combination biofertilizer amendment on (A) Chlorophyll content (mg g^{-1} leaf fresh weight)* (B) Protein content (mg g^{-1} leaf fresh weight)* (C) Soluble carbohydrate content (mg g^{-1} leaf fresh weight)* of black gram

Effluent concentration (%)	A. chlorophyll Plant age (days)				B. protein Plant age (days)				C. soluble carbohydrate Plant age (days)			
	20	40	60	80	20	40	60	80	20	40	60	80
Control	1.222 cd	2.388 c	1.844 de	1.208 c	1.370 c	8.230 d	5.760 def	1.040 de	1.764 b	2.576 b	2.312 bc	1.984 bc
25	1.502 a	2.526 b	1.992 c	1.530 a	2.120 b	9.660 c	6.410 c	1.880 b	1.636 c	2.640 ab	2.336 b	1.968 c
50	1.054 e	2.208 d	1.724 f	1.264 d	0.780 e	5.394 f	4.220 g	0.630 f	1.212 d	2.208 e	1.896 d	1.388 e
75	0.790 f	1.960 e	1.628 g	0.840 f	0.540 f	3.970 g	3.000 h	0.480 g	1.092 e	1.588 d	1.396 e	1.176 f
100	0.500 g	1.790 f	0.812 h	0.456 g	0.480 f	2.560 h	1.760 i	0.180 h	0.872 f	1.272 e	1.160 f	0.984 g
T_1 Biologically treated effluent	1.166 cde	2.366 c	1.874 d	1.248 de	1.260 d	8.120 de	5.620 f	0.950 e	1.740 b	2.508 b	2.164 c	1.872 d
T_2 Biologically treated effluent biofertilizer	1.284 bc	2.526 b	2.146 b	1.380 c	2.420 a	11.840 a	5.870 de	1.760 c	1.912 a	2.620 ab	2.308 bc	2.028 abc
T_3 Factory treated effluent	1.108 de	2.352 c	1.810 e	1.296 d	1.310 cd	7.488 e	5.700 ef	1.100 d	1.800 b	2.640 ab	2.264 bc	1.968 c
T_4 Factory treated effluent biofertilizer	1.390 ab	2.636 a	2.236 a	1.472 b	2.150 b	11.540 ab	7.680 b	1.960 b	1.976 a	2.752 a	2.416 ab	2.056 ab

*Based on five determinations for each treatment (DMRT Duncans Multiple Range Test)
Values with same alphabets in each sampling day in the columns do not differ significantly from each other ($P<0.05$)

Table 2: Impact of raw effluent dilutions, biologically treated effluent and treated effluent from dye factory in combination with biofertilizer amendment on the yield* of *Vigna mungo* (L.) Hepper

Effluent concentration (%)	Yield	
	Pod length (cm)	Number of seeds per pod
Control	5.820 ab	8.400 bcd
25	6.120 a	9.400 a
50	4.940 c	6.800 e
75	3.960 d	5.000 f
100	2.920 e	4.200 f
T_1- Biologically treated effluent	5.840 ab	7.800 cd
T_2- Biologically treated effluent + biofertilizer	5.940 ab	7.600 de
T_3- Factory treated effluent	5.800 ab	8.600 abc
T_4- Factory treated effluent + biofertilizer	6.020 a	8.800 ab

*Based on five determinations for each treatment (DMRT-Duncans Multiple RangeTest)
Values with same alphabets in each sampling day in the columns do not differ significantly from each other (P<0.05)

biofertilizer amendment (T_4). Plants irrigated with biologically treated effluent amended with biofertilizer (T_2) and 25% effluent concentration also showed high chlorophyll content. However there was a progressive and significant decrease in chlorophyll content with increasing concentrations (75% and 100%) of the raw effluent. Similar trend was noticed by Agarwal and Agarwal (1990); Gupta and Nathawat (1991) and Mamta and Naik (1992). Dilution seemed to neutralize the toxic effect of the dye effluent and hence promoted chlorophyll content.

Highest protein and soluble carbohydrates were recorded in 40-day-old plants which declined thereafter. Significant reduction of protein and soluble carbohydrate contents were noticed in raw effluent treatments. Pronounced increase in the biochemical constituents was observed in plants raised on soil amended with biofertilizer and irrigated by treated effluents [factory treated (T_4) and biologically treated (T_2)] and 25% effluent concentration. These observations are in agreement with the studies of Muthuchelian *et al.* (1988), Mane and Shitole (1989) and Jain and Khan (1996).

The yield (Table 2) of *V.mungo* was evaluated in terms of pod length and number of seeds per pod. 25% effluent concentration and treated effluents [factory treated (T_4) and biologically treated (T_2)] with biofertilizer amendment recorded maximum yield. Higher concentrations (75% and 100%) of raw effluent significantly decreased the yield. This is in agreement with Jabeen and Saxena (1990).

From the above observations it can be concluded that the dye effluent had an adverse effect on plant growth when used in high concentrations, but recycling it to a proper dilution brings down its toxic effect and can be useful for irrigation. The deleterious effect of the dye factory effluent can be minimized by using the aquatic macrophyte (*Eichhornia* sp.) which has a wonderful proliferation rate and property of absorption of pollutants from waste water. Besides, the incorporation of biofertilizer amendents to the effluent irrigated soil enriched the soil and had a beneficial effect on the plant.

● LITERATURE CITED ●

Agarwal, R. and Agarwal, S.K. (1990). Physico – chemical characteristics of kota printing effluent, its effect on seed germination and seedling growth of crop plants. *Acta Ecol.*, **12** (2) : 112-118.

Arnon, D.I. (1949). Copper enzymes in isolated chloroplasts. Polyphenoloxidase in *Beta vulgaris. Plant Physiol.*, **24**: 1-15.

Clegg, K.M. (1956). The application of the anthrone reagent to the estimation of starch in cereals. *J.Sci. Food agric.*, **7**:40-44.

Cornwell, D.A., Zoltek Jr.J., Patrinely, C.D., de Furman,S. and Kim, J.I. (1977). Nutrient removal by waterhyacinth. *J. Water Pollut. Cont. Fed.*, **49** (1) : 57.

Gersberg, R.M., Elkin, B.V. and Goldman, C.R. (1984). Use of artificial wetlands to remove nitrogen form wastewater. *J. Water Poll. Cont. Fed.*, **56**:152-156.

Gupta, A. and Nathawat, G.S. (1991). Effect of textile effluent on seed germination and seedling growth of *Pisum sativum* var. RPG – 3, *Acta. Ecol.*, **13**(2): 109-112.

Jabeen, S. and Saxena, P.K. (1990). Effect of industrial effluent on growth behaviour of *Pisum sativum. Geobios*, **17**: 197-201.

Jain, V. and Khan, T.I. (1996). Effects of waste water from textile industry on *Cyamopsis tetragonoloba* var. RGC 986. *Environ. Edn. Infrm.*, **15** (1): 67-72.

Lowry, O.H., Rosebrough, N.J., Farr, A.L. and Randal, R.J. (1951). Protein measurement with folin reagent. *J. Biol. Chem.*, **193** : 265-275.

Maguire, J.D. (1973). Physiological disorders in germinating seeds induced by the environment. Seed Econogy Proc. Univ. Nottigham (Ed.H Heydocker) 288 pp.

Mamta, G. and Naik, M.L. (1992). Effect of fertilizer effluent on chlorophyll contents of *Cyamopsis tetragonoloba* Taub.*J. Environ. Biol.*, **13**:169 -174.

Mane, T.T. and Shitole, M.G. (1989). Productivity of methi (*Trigonella foenum – graecum*) on physico-chemical properties of soil under pulp and paper mill treated effluent irrigation. Proc. Ind.Sci.,Cong., Part-III. 144 pp.

Mhatre, G.N. and Chaphekar, S.B. (1982). Effect of heavy metals on seed germination and early growth. *J.Environ. Biol.,* **3** : 53-63.

Muthuchelian, K., Rani, S.M.V., Kandasamy, G. and Paliwal, Kailash (1988). Influence of sewage water and sewage soil on photosynthesis, nitrate reductase activity and biomass accumulation of *Phaseolus mungo* L. *Indian J. Environ. Hlth*., **30** (4): 367-371.

Natarajan, T. and Oblisami, G. 1980. Effect of bacterial inoculation on maize. Paper presented at the Naional Symposium on BNF in relation to crop production, TNAU, Coimbatore, India.

Subrahmanyam, P.V.R., Juwarkar, A.S. and Sundaresan, B.B. (1984). Utilization of pulp and paper mill waste water for crop irrigation. In: Proceedings of Asian Chemical Conference on Priorities in Chemistry in Development of Asia. Priochem Asia, Kualalumpur, Malaysia. pp. 26-31.

Subramani, A., Sundramoorthy, P. and Lakshmanachary, A.S. (1998). Impact of fertilizer factory effluent on the morphometrical and biochemical changes of cowpea [*Vigna unguiculata* (Linn.) Walp.]. *Plant Sci*., **11** (1): 137-141.

Sujatha, P. and Gupta, A. (1996). Tannery effluent characteristics and its effects on Agriculture. *J.Ecotoxicol. Environ. Monit*., **6** (1): 045 – 048.

Wolverton, B.C. (1975). Waterhyacinth for removal of Cd and Ni from polluted water. NASA Technical Memorandum No: TM-X-72:721

● ● ● ● ● ● ●