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Impact Of Combined Industrial Effluent On Seed Germination, Seedling Growth And Chlorophyll Content Of French Bean Phaseolus Vulgaris L. Var. Anupama.

KEYWORDS: Combined industrial effluent, Seed germination, chlorophyll, Phaseolus vulgaris.

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ABSTRACT *The present study was conducted to analyse the impact of combined industrial effluent on Phaseolus vulgaris L. A pot culture experiment was conducted to study the effect of combined industrial effluent collected from the drain of industrial area of Kathua. The different concentrations (25%, 50%, 75% and 100%) of combined industrial effluent were used for irrigating the crop plants and tap water was used in control set. The effluent showed unpleasant odour, alkaline pH, and high concentration of chlorides. The various parameters studied were percentage seed germination, root length, shoot length and chlorophyll content in the crop plants. The study demonstrated that the lower concentrations of the industrial effluent caused a positive impact on seed germination, growth and chlorophyll content of Phaseolus vulgaris L. However at higher concentrations of the effluent, toxic effects were observed from 20th day onwards. This suggested that the effluent could be used safely for Phaseolus vulgaris cultivation only after proper treatment and dilution.*

Introduction

Industrialization is gradually becoming the keyword in the developmental process of the developing nations of the world. One of the biggest problems responsible for deterioration of urban as well as rural environment is the industrial pollution. Though industrialization and development in agriculture are necessary to meet the basic requirement of people, at the same time it is necessary to preserve the environment. Among various industries, textile industry is equally considered as an intensive water consuming activity besides utilizing a wide variety of chemicals and dyes (Kanmani and Thanasekaran, 2003). This combined industrial effluent includes the effluent from textile, paint, battery manufacturing, electroplating and pulp and paper industries.

Many scientists have documented adverse effects of different effluents on the growth of plants. Industrial waste water has also been found toxic to several crop plants. Adverse effects on seed germination and growth of many crops have been reported by several workers in their experimental studies. Despite of enforcement of Water (Prevention and Control of Pollution) Act, 1974 the waste water from industries are mostly discharged untreated over the land or in water courses and cause severe problems to aquatic animals and plants.

Study Area

The collection of combined industrial effluent was made from a big drain in the industrial area at Kathua. The physico-chemical analysis of the collected sample and its impact study on Phaseolus vulgaris L. var. Anupama was done in the Department of Environmental Sciences, University of Jammu, Jammu.

Materials and Methods

The garden soil collected from the Department of Arboriculture, University of Jammu was first sun dried, sieved and mixed with Farmyard manure (FYM) in the ratio of 3:1. The tested seeds of Phaseolus vulgaris L. were purchased from local seed store.

The experimental set up was designed in the form of four treatment sets and one control set using tap water for irrigation. Each treatment set contained ten polythene bags filled with about 2 Kg prepared soil. In each bag ten seeds were sown and on 20th day of germination three plants were uprooted from each experimental set and different parameters were studied. Germination Index was calculated by the formula of Zucconi et al. (1981). Root length and shoot length were determined using standardised scale. Chlorophyll content was determined by using the method given by Hiscox and Israelstam, 1979. The analysis of effluent was done by the methods of APHA, 1998 and 850 Professional Ion chromatograph system supplied from Metrohm Switzerland.

Observations: Table I – V.

Results and Discussion

The collected combined industrial effluent was bluish black having unpleasant odour with pH 8.7, EC of 3.9 mS/cm, Turbidity 20 NTU and Temperature of 55^{0}C. The analysis of the physico-chemical properties of the effluent used for irrigation revealed that the parameters like BOD, chloride, nitrate, sodium, potassium, calcium, magnesium and ammonium showed increase in values with increase in the concentration of the effluent but DO showed the decreasing trend with increase in the concentration of the effluent (Table I).

The maximum (75%) seed germination was recorded in control set and minimum (32%) at 50% effluent concentration The seed germination index was also maximum (10.93) in the control set and minimum (4.19) in 50% effluent concentration, Table II. Reduction in seed germination percentage at all concentrations of combined industrial effluent seems due to the higher amount of solids present in the effluent, which caused change in osmotic relationship of seed and water. Thus reduction in the amount of water absorption takes place, which resulted into retardation of seed germination. The other possibility of reduction in germination percentage at all concentrations of effluent may be due to presence of excess amount of ammonia in ef-

Volume : 4 | Issue : 10 | October 2014 | ISSN - 2249-555X

fluent. Kirby, 1968 reported presence of excess amount of ammonia in effluent caused depletion of the Tricarboxylic acid cycle, which reduced the respiration rate and subsequently seed germination. Saxena et al. (1986) reported that the low amount of oxygen in dissolved form due to the presence of higher concentration of solid in the effluent, reduces the energy supply through anaerobic respiration resulting in restriction of the growth and development of the seedling.

Increase in concentration of combined industrial effluent exhibited significant ($p<0.05$) negative impact on shoot length as well as root length at 20 days (r=-0.9 and -0.8); 40 days (r=-0.8 and-0.8) and 60 days (r=-0.9 and -0.7) respectively (Table III & IV). Increase in concentration of combined industrial effluent also exhibited significant ($p<0.05$) negative impact on total chlorophyll content at 20 days (r=-0.82); 40 days (r=-0.82) and at 60 days (r=-0.86), Table V. The exposure of plant to all concentrations of combined industrial effluent to the seedling exhibited inhibition in growth, overall development of the seedling and chlorophyll content. Izawa (1977) suggested that the inhibition of chlorophyll at higher effluent concentration may be due to the induced inhibition of Electron Transport System in PS-I. The significant fall in chlorophyll content under the higher percentage of effluent concentration might have been due to inhibitory effect of toxicants of effluent on chlorophyll synthesis in plants which consequently inhibited the growth of root as well as shoot.

Tablel : Physico-chemical characteristics of combined industrial effluent from Kathua industrial area.

Physical parameters	Effluent characteristics			
Colour	Bluish black			
Odour	Unpleasant			
Temperature (^{0}C)	55			
pH	8.7			
Turbidity (NTU)	20			
EC (mS/cm)	3.9			
Chemical parameters (mg/l)	25%	50%	75%	100%
DO	3.9	2.7	1.18	0.79
BOD	23	32	38	47
Chloride	41.5	63.2	139.6	248.6
Nitrate	1.26	6.26	6.97	7.16
Sodium	374	622	1074	1563
Potassium	27.8	45.5	76.2	114.7
Calcium	39.0	63.3	110	158.4
Magnesium	13.6	24.5	47.4	72.7
Ammonium	10.8	14.1	24.3	37.1

Table II: Impact of combined industrial effluent on percentage seed germination and seed germination index in Phaseolus vulgaris L. var. Anupama.

Experimental sets	No. of seeds germinated on day										Percentage seed germination	Seed germination index
	1	2	3	4	5	6	7	8	9	10		
Control set	0	0	0	7	8	9	14	11	10	16	75	10.93
Set1 (25%)	0	0	0	0	3	7	9	8	6	10	43	5.70
Set 2 (50%)	0	0	0	2	1	3	4	5	9	8	32	4.19
Set3 (75%)	0	0	0	2	2	2	4	8	8	10	36	4.37
Set 4 (100%)	0	0	0	0	5	7	5	5	13	6	41	5.49

Table III: Impact of combined industrial effluent on average shoot length (cm) in plants of Phaseolus vulgaris L. var. Anupama.

Age of plant	Average shoot length (cm.) in					Pearson's coefficient(r) and significance (p)
	Control set	Set 1	Set 2	Set 3	Set 4	
20th day	22.53±3.91	20.73±2.05	17.96±5.18	16.26±2.95	13.90±1.83	r= -0.997 p= 0.0019
40th day	43.33±5.65	28.7±2.02	24.03±7.32	22.40±5.46	20.1±0.45	r= -0.898 p=0.004
60th day	54.76±5.75	42.6±5.47	35.46±7.73	34.26±7.15	32.90±11.3	r= -0.908 p=0.0012

Table IV: Impact of combined industrial effluent on average root length (cm) in plants of Phaseolus vulgaris L. var. Anupama.

Age of plant	Average root length (cm.) in					Pearson's coefficient (r) & significance (p)
	Control set	Set 1	Set 2	Set 3	Set 4	
20th day	7.56±0.20	5.4±0.45	4.96±0.20	4.93±0.73	4.66±0.66	r= -0.839 p= 0.041
40th day	13.5±1.3	7.86±0.32	7.56±0.81	7.33±0.45	7.1±0.91	r= -0.687 p= 0.016
60th day	15.53±0.60	8.76±0.55	8.03±0.45	7.93±0.75	7.43±0.70	r= -0.795 p= 0.023

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Table V: Impact of combined industrial effluent on chlorophyll a, b and total chlorophyll content (mg/g) in the plants of Phaseolus vulgaris L. var. Anupama

Age of plant	Chlorophyll a (mg/g) in						Chlorophyll b (mg/g) in						Total chlorophyll (mg/g) in					
	control	Set 1	Set 2	Set 3	Set 4	p,c (r) & significance	control	Set 1	Set 2	Set 3	Set 4	p,c(r) & significance	control	Set 1	Set 2	Set 3	Set 4	p,c(r) & significance
20th day	0.00295	0.00076	0.00076	0.00043	0.00005	r=-0.85 p=0.04	0.00082	0.00042	0.00032	0.0038	0.00051	r=-0.52 p=0.047	0.00394	0.012	0.0011	0.008	0.005	r=-0.82 p=0.047
40th day	0.0070	0.0033	0.0032	0.0031	0.017	r=-0.86 p=0.047	0.0088	0.0015	0.0008	0.005	0.0003	r=-0.78 p=0.047	0.0163	0.005	0.004	0.003	0.002	r=-0.82 p=0.048
60th day	0.0071	0.0033	0.0033	0.0032	0.0030	r=-0.75 p=0.047	0.0089	0.0017	0.0010	0.010	0.0006	r=-0.77 p=0.047	0.0165	0.053	0.0046	0.045	0.039	r=-0.86 p=0.048

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