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Chemical composition of camphor factory and distillery factory effluent and its effect on nutritional content of two rabi crops *viz*. gram & pea

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The physico–Chemical characteristics of effluents from two different industries *viz*. Camphor and Allied Products Ltd. Bareilly and Superior Industry Ltd. Bareilly, were assessed and the effect of various concentrations (0%, 25%, 75% and 100%) on mineral uptake in Gram and Pea was determined. The study revealed that the % germination of Gram and Pea was severely affected by these effluent at higher concentrations, where a maximum germination was observed at 25% effluent concentration. The uptake of Fe, PO_4, Zn and Cu was found to in increasing order and was highest at 100% effluent concentration. The above study reveals that the feasibility of using industrial effluent for growing vegetables and crops with proper dilution.

Keyword: camphor factory and distillery factory, nutritional content, two rabi crops *viz*. gram, pea

Introduction

Camphor and Allied Product Ltd. and Superior Industry Ltd C.B. Ganj Bareilly both are biggest camphor and ethyl alcohol producing industrial unites. Effluents of these industries contribute toward environmental pollution, particularly to the aquatic ecosystem. There is a great demand of water for irrigation, while gallons and gallons of effluent's are left out into water resources as untreated. The disposal of water is a major problem faced by industries, due to the germination of high volume of effluent and with linked space for land-based treatment and disposal[1,2]. On the other hand waste water is also a resource that can be applied for productive use, since waste water contains nutrients that have the potential for use in agricultural aquaculture and other activities effluent of both industries contain a significant concentration of suspended solids, dissolved solids, high BOD, COD, considerable amount of chlorides, sulphate, nitrate, Ca and Mg concentration[3]. Diverse both industries effluents disposed off in soil and water cause major pollution problem, while these industries play an important role in the economic developments of India, but the effluents released produce a high degree of organic pollution in both aquatic and terrestrial ecosystem[4]. Because camphor industry effluent is commonly used for irrigation. It is essential to determine how crops respond when exposed to industrial effluent. In this regard effort have been made to determine the effect of industrial effluents on seed germinations of various crops [5]. Distillery factory is also one of the largest and old industry present globally and considered to be one of the biggest threats to the environment produces large amount of waste that contain organic and inorganic compounds.

The present study deals with the effect of these industrial effluents on certain physico-chemical properties of soil, germination and the mineral uptake by the two rabi crops.

Experimental

The effluents from the both industries at the discharge point were collected at fortnightly intervals and was analysed according to A.P.H.A (1980). Quantitative estimation of heavy metals in effluents were made by using atomic absorption spectrophotometer (AA S300 Perkin & Elmer).

The seeds of gram and pea were kept in petri dishes lined with three layers of whatman filter paper no.1 moistened with different concentration of effluents *viz*. 25%, 50%, 75%, 100%. A control with distilled water was also set. The emergence of radical and plumule was considered as criterion of germination. Each treatment was replicated three times for all crops.

Data were analysed statistically according to Snedecor & Coch-Chran [7] (1967).

Results and Discussion

The physico-chemical characteristics of camphor and distillery industries effluent are given in Table 1. The physico- chemical characteristics of both industries effluents indicate its acidic nature. From the above results it is clear that large amount of TSS is responsible for high BOD & COD of the effluents, which were found to be above permissible limit. i.e. BOD 50 ml/L and COD 250 Ml/L (BIS 2010) [8]. The absence of DO indicates high organic matter of the effluent. The presence of heavy metals was not detectable. On the other hand physico-chemical analysis of distillery industry reveals that the sample was also acidic in nature and contains considerable amount of Ca, Mg, TSS, high COD and other basic nutrients above the permissible limits: [9, 10].

Table 1: Physico – chemical characteristics of Industrial effluents.

Parameters	Camphor Factory	Distillery Factory
pH	4.0	5.1
EC. (μ mhos/cm)	2890	8300
BOD mg/L	850	710
COD mg/L	3250	1100
DO mg/L	Nil	7.1
Ca mg/L	122	280
Mg mg/L	80.6	138
Acidity (mg/L)	10.2	0.6
TSS mg/L	390	928
PO_4 mg/L	3.2	1.4
Cl mg/L	1.47	300
Fe mg/L	ND	ND
Zn / mg/L	ND	ND
Cu mg/L	ND	ND
Cr mg/L	ND	ND
Cd mg/L	ND	ND
Pb mg/L	ND	ND

Germination test was conducted with seeds of gram and pea with different effluents concentration (25%, 50%, 75%, 100%). The % germination was recorded up to 10th day. The seed germination 100% in control for Pea as well as gram. Percentage germination decreases from 97.6% to 88.6% in 50%, 75%, 100% effluent concentrations [11]. Dried plant material was taken and analysed for Ca, Mg, Na, K, P, Fe, Zn and Cu, in camphor factory effluent treated crop Ca, Mg, and K content was hither in 25% concentration than that of control. The Ca content in gram was recorded 5.741% in 25% concentration and 5.21% (control) and in the pea 5.75% in 25% concentration. The Na content was recorded a decrease with increase in effluent concentration ranging from 0.938-1.024% in gram and 1.003-1.07% in pea. The micro nutrients such as Fe ranged from 0.487 -0.489 mg/ 100g in gram and 0.4818 - .4820 mg/ 100 g in pea. The increased values except Na may be due to the presence of soluble salts and organic matter which was found to be high in camphor factory effluent, and the decrease in Na uptake by the plant may be due to the lower pH of the effluent [12]. It has been revealed that the plant have observed more K and Mg failed to uptake the required amount of the Na and hence are deficient in Na contents deposit soil having adequate Na.

Table 2: Effect of camphor factory effluent on mineral content of two rabi crops at different dilutions

Crops	% Mineral content	Control	25%	50%	75%	100%	F	CD
GRAM	Ca	5.211 ± 0.280	5.741 ± 0.456	5.560 ± 0.24	5.11 ± 0.348	4.91± 0.246	1.25**	0.042
	Mg	2.13 ± 0.321	2.23 ± 0.631	2.17±0.321	2.17 ± 0.567	2.07 ±0.241	1.02 ***	0.56
	K	1.162 ± .182	1.396 ± 0.321	1.248 ± 0.241	1.186 ± 0.321	1.148 ± 0.124	12.67**	0.078
	Na	1.024 ± 0.123	0.991 ± 0.212	0.980 ± 0.341	0.975 ± 0.221	0.938 ± 0.121	170.24***	0.067
	PO_4	0.88±0.125	0.97± 0.144	0.97± 0.221	1.02 ± 0.515	1.05 ± 0.312	210.40***	0.074
	Fe	0.4871 ± 0.34	0.4870± 0.121	0.4876± 0.241	0.4880± 0.514	0.4894± 0.412	2.64***	0.086
	Zn	0.2849 ± 0.121	0.2849± 0.124	0.2855± 0.241	0.2858± 0.561	0.2862±0.441	7.64**	0.073
	Cu	0.3402±0.46	0.3406±0.354	0.3408±0.511	0.3411±0.126	0.3417±0.341	12.40***	0.064
PEA	Ca	5.571 ± 0.126	5.751±0.128	5.570±0.221	5.450±0.21	5.393± 821	2.64**	0.103
	Mg	2.26±0.128	2.35±0.126	2.26±0.220	2.31±0.214	2.20±0.125	3.76**	0.024
	K	1.88±0.416	1.303±0.311	1.217±0.234	1.164±0.331	1.124±.043	101.64***	1.67
	Na	1.030±0.513	1.042±0.314	1.020±0.341	1.003±0.312	1.003±0.124	201.34**	0.27
	PO_4	0.91±0.312	0.97±0.126	0.99±0.441	1.02±0.314	1.04±0.561	500.41***	1.33
	Fe	0.4818±0.413	0.4812±0.264	0.4813±0.128	0.4816±0.412	0.4820±0.511	17.64**	0.071
	Zn	0.2908±0.311	0.2909±0.301	0.2912±0.221	0.2917±0.211	0.2917±0.210	13.46***	0.310
	Cu	0.3353±0.511	0.3357±0.216	0.3358±0.310	0.3359±0.231	0.3351±0.341	164.51***	0.078

(Significant at P**<0.01, significant at p***<0.001)

Table 3: Effect of distillery factory effluent on mineral content of two, rabi crop at different concentration

Crops	% Mineral content	Control	25%	50%	75%	100%	F	CD
GRAM	Ca	5.73 ± 0.126	5.61 ± 0.511	5.39 ± 0.412	5.27 ± 0.126	5.27± 0.126	2.31***	0.046
	Mg	2.30 ± 0.121	2.18 ± 0.128	2.14± 0.512	2.13 ± 0.122	2.11 ±0.120	2.46 **	0.076
	K	1.137 ± 0.511	1.28 ± 0.186	1.24 ± 0.122	1.21 ± 0.129	1.21 ± 0.105	103.6***	0.31
	Na	1.13 ± 0.211	1.18 ± 0.121	1.070 ± 0.126	1.06 ± 0.123	1.05 ± 0.127	270.10***	0.031
	PO_4	0.873±0.126	0.874±0.124	0.864 ± 0.186	0.859 ± 0.126	0.859 ± 0.126	160.3***	0.34
	Fe	0.4855 ± 0.216	0.4862± 0.156	0.4864± 0.211	0.4865±0.221	0.4867± 0.127	189.20***	0.101
	Zn	0.2890 ± 0.082	0.2892± 0.155	0.2896± 0.610	0.2897± 0.126	0.2899±0.186	89.6**	0.076
	Cu	0.3560±0.126	0.3565±0.512	0.3569±0.126	0.3572±0.226	0.3573±0.154	12.6***	0.086
PEA	Ca	2.53 ± 0.128	5.63±0.216	5.51±0.216	5.46±0.126	5.41± 0.173	14.6**	0.076
	Mg	2.46±0.124	2.36±0.126	2.30±0.212	2.26±0.176	2.24±0.131	13.5**	0.77
	K	1.135±0.126	1.30±0.512	1.29±0.196	1.28±0.126	1.26±.131	102.6***	0.87
	Na	1.050±0.241	1.050±0.216	1.05±0.210	1.04±0.176	1.03±0.311	500.6***	0.076
	PO_4	0.814±0.156	0.837±0.186	0.825±0.127	0.811±0.126	0.807±0.121	13.67**	0.34
	Fe	0.4922±0.261	0.4924±0.211	0.4926±0.121	0.4926±0.161	0.4929±0.106	206.7***	0.079
	Zn	0.2930±0.231	0.2932±0.126	0.2934±0.176	0.2938±0. 121	0.2942±0.136	106.3***	0.087
	Cu	0.3602±0.512	0.3608±0.128	0.3612±0.187	0.3609±0.171	0.3614±0.126	214.7***	0.096

(Significant at P**<0.01, significant at p***<0.001)

In distillery factory effluent nutrient uptake by plant at 25% concentration was at par with control and then decrease with increase in effluent concentration as shown in label 3. The Ca control varied from 5.37% to 5.73% in gram and 5.41% to 5.53% in pea. The Mg content ranged from 2.11 – 2.30% in gram and 2.24 - 2.46% in pea. The Na and K content varied from 1.21- 1.37% and 1.05-1.13% in gram and 1.27 – 1.36% and 1.03- 1.08% in pea. The Cu contain varied from 0.3562-0.3573 mg/100gm in gram and 0.3610–0.3613 mg/100gram in pea. The effluent treatment caused a considerable difference in the uptake of various nutrients by the seedlings in all the crops. The uptake of Ca, Mg and K was highest at 25% effluent concentration in all crops. In gram, the Ca uptake was also higher in 50% effluent concentration in comparison to control while when compared to others, crops at 50% effluent concentration the uptake of nutrients was equal to the control value. Mg and K concentration was more than the control value up to 75% concentration was more than the control value upto 75% concentration in most of the crops. Na uptake was found to be less than controls value at all the concentration for all the crops. The uptake of Fe, PO_4, Zn and Cu was found in increasing order and was highest at 100% effluent concentration. The macronutrients uptake such as Ca, Mg, K either increased up to 25% effluent concentration in comparison to control. Although the increased value showed marginal difference at higher concentration, these values showed marginal difference at higher concentration, these values were in decreasing order for both the crops. The uptake of Na was high at 25% effluent concentration in comparison to control in gram [13]. Where as in pea at 25% concentration the value was slightly less than the control. The uptake of PO_4 was found to be in the decreasing order in both the crops with the increase in effluent concentration. The micronutrients Fe, Zn and Cu uptake show marginally increased values in the increasing order of the effluent concentration [14].

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