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Remedial measures for biotoxicities of water pollutants by using nitrogenous and phosphatic fertilizers as detoxicants, their effect on dry matter yield of lettuce plants

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Abstract

A study was conducted in adjourning area of Agra city and Mathura refinery for the use of sewage water and refinery effluents irrigation to observed the effect on dry matter yield of lettuce plant with the application of nitrogen and phosphorus. The application of 0,2,4 and 6 irrigation was done and 30, 60 and 90 nitrogen level (PPM) and 25,50 and 100 phosphorus levels (PPM) was done. The study revealed that the maximum yield was recorded with highest number of irrigation (six) with sewage water. Our investigation further indicated that the dry matter yield of lettuce plant was significantly increase with increasing level of nitrogen application . The dry matter yield increased 26.31 and 48.82 percent with 60 and 90 ppm level of nitrogen and 17.61 and 27.97 percent with 50 and 100 ppm level of phosphorus. The data further indicated that the dry matter yield of lettuce plant was reduced significantly with increasing the number of irrigation with refinery effluents.

Key words: Sewage, Refinery, Nitrogen, Phosphorus and Dry matter Yield

Introduction

Some heavy metals, such as Cu and Zn, have known functions as micronutrients in plants, they become toxic at high levels. High accumulation of metals affects both growth and metabolism of plants (Baccouch *et al*.,**[1]**). These phytotoxic effects of heavy metals depends on metal concentration, plant species, pH and other factors in soil (Chandra *et al*., **[2]**). Due to heavy metal stress the production of reactive oxygen species (ROS) causes damage to the plant cells. The antioxidants produced in cells defend the biochemical activities and provide tolerance in plants under stressed conditions (Asada **[3]**). The accumulation of heavy metals in plants exposed to industrial waste water, and their affects on growth and metabolism of plants need extensive studies for various research purposes. Common effluent treatment plant located in Unnao district, U.P. state, India discharges waste water from a large number of industries into a drain after treatment. This waste water is used for irrigational purposes in agricultural fields on both sides of the drain. Therefore, the present study was aimed to explore the uptake of some heavy metals present in industrial waste water by lattuce (*Lactluca sativa L.*) plants after exposure. Also the irrigational impact of the industrial waste water was observed to find tolerance limit to metal concentration, growth and biochemical changes in lettuce plants.

Materials and Methods

In order to suggest the remedial measures for toxicities of heavy metals in lettuce, two separate pot experiments (two experiments for sewage water and two experiment of refinery) were carried out for two consecutive years the Department of Chemistry, R.B.S. College, Agra. The details with regards to technical programme are given below :-

Details of Technical Programme

The two pot experiments were conducted in greenhouse using, nitrogenous and phosphatic fertilizers as amendments/ detoxicants. The details are as below:-

Experiment I : (Using Nitrogenous fertilizers)

(i) Levels of Nitrogen :
Three (30, 60 and 90 ppm)

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(ii) Sewage and refinery Four : (Ordinary water, 2,4 and 6) Water (irrigation)
(iii) Replication : 3
(iv) Design : R.B.D.
(v) Crop : Lettuce
Total No. of Pots : 3 x 4 x 3 =36

Experiment –II : (Using Phosphatic fertilizers)

(i) Levels of Phosphorus : Three (25, 50 and 100 ppm)
(ii) Sewage and refinery : Four(Ordinary water, 2, 4 and 6) water (irrigation)
(iii) Replication : 3
(iv) Design : R.B.D.
(v) Crop : Lettuce
Total No. of Pots : 3 x 4 x 3 =36

The calculated amount of nitrogen and phosphorus were applied through A.R. grade urea and potassium dihydrogen phosphate, respectively. The sewage and refinery waters applied would be six cm. per irrigation. All recommended agronomic practices were adopted.

Results and Discussion

The study on use of sewage water and refinery effluents on growing lettuce plants to suggest the remedial measures for toxicities of heavy metals in lettuce, two pot experiments were conducted in pot house using nitrogenous and phosphatic fertilizers as detoxicants. The results obtained on different aspects with respect to different experiments are presented in table 1 and 2.

It is noted from Table-1 and Table-2 that the dry matter yield of lettuce plants was significantly affected by number of irrigations with sewage water. The number of irrigation with sewage water significantly enhanced the dry matter yield of lettuce plants.

The maximum dry matter yield was recorded under highest number of irrigations (six) with sewage water. It is clear that dry matter yield of lettuce crop significantly improved with increasing levels of detoxicants as compared with lower levels. Like the above, dry matter yield increased by 26.31% and 48.82% with 60ppm and 90ppm levels of nitrogen over 30ppm level, respectively.

It is also noted that, the dry matter yield increased by 17.61 and 27.97 percent with 50ppm and 100ppm levels of phosphorus over 25ppm level, respectively.

Further evaluation of data the table-1 and 2 indicate that the dry matter yield of lettuce plants reduced significantly with increasing number of irrigations with refinery effluents. The minimum dry matter yield of lettuce plants was recorded under maximum number of irrigation (6) with refinery effluents. The dry matter yield increased significantly with increasing levels of each detoxicant over lower levels irrigating with refinery effluents. Similarly, the dry matter yield also increased by 24.14% and 45.17% with 60ppm and 90ppm levels of nitrogen over 30ppm

Table1: Effect of polluting material (sewage and refinery effluent) and nitrogen (%) application on dry matter yield (gm/pot) of lettuce plants

Treatment	Sewage water			Refinery Effluent		
	2013	2014	Mean	2013	2014	Mean
No. of Irrigation						
0	4.32	4.47	4.39	4.08	4.13	4.11
2	5.19	5.36	5.23	4.03	4.08	4.05
4	8.27	8.35	8.31	3.72	4.01	3.86
6	10.24	10.46	10.35	3.66	3.77	3.71
S.Em±	0.006	0.005	-	0.007	0.006	-
C.D. at 5%	0.018	0.017	-	0.021	0.019	-
Nitrogen Levels (ppm)						
30	5.44	5.57	5.51	3.47	3.57	3.52
60	6.84	7.09	6.96	4.25	4.49	4.37
90	8.14	8.26	8.20	5.08	5.15	5.11
*S.Em±	0.012	0.005	-	0.006	0.011	-
**C.D. at 5%	0.036	0.015	-	0.019	0.033	-

Table2: Effect of polluting material (sewage and refinery effluent) and phosphorus (ppm) application on dry matter yield (gm/pot) of lettuce plants

Treatment	Sewage water			Refinery Effluent		
	2013	2014	Mean	2013	2014	Mean
No. of Irrigation						
0	4.09	4.20	4.15	4.15	4.28	4.22
2	5.07	5.21	5.14	4.02	4.16	4.09
4	7.69	7.82	7.76	3.90	4.05	3.97
6	9.64	9.78	9.71	3.81	3.92	3.87
S.Em±	0.008	0.005		0.002	0.005	
C.D. at 5%	0.025	0.015		0.006	0.013	
Nitrogen Levels (ppm)						
30	5.80	5.79	5.79	3.28	3.39	3.34
60	6.78	6.83	6.81	4.29	4.40	4.35
90	7.32	7.49	7.41	4.78	4.88	4.83
*S.Em±	0.002	0.001		0.005	0.005	
**C.D. at 5%	0.007	0.004		0.013	0.013	

*S.Em± = Standard error of mean
**C.D. = Critical difference

level, respectively. In general, the dry matter yield also improved by 30.23% and 44.61% with 50ppm and 100 ppm over 25ppm level of phosphorus respectively.

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