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Study on the effect of Hindalco industry effluents on growth and reproduction of some leguminous crop plants

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ABSTRACT

Effect of different sites of Hindalco industry effluents on germination of seeds of *Cajanus cajan* cv. Bahar, *Pisum sativum* cv. Azaad; *Cicer arietinum* cv. G-I30 and *Cicer arietinum* cv. H-208 was studied. The maximum inhibition in seed germination was reported in site-I treated seeds, whereas it was minimum in site-3 treated seeds. Among two cultivars of *Cicer arietinum* cv. H208 is more susceptible to chemical industry effluent toxicity than cv. G-130. In this way differential responses are shown by above stated genotypes of *Cicer arietinum* to Hindalco industry effluent toxicity.

1. Introduction

Rapid progress in science and technology has been of great advantage to human beings, but environmental pollution has become its byproduct. The improper management of atmosphere, hydrosphere and the lithosphere resulted into adverse effects on plants and animals[1]. Pollution due to industrial waste is increasing and it is a problem throughout the world. The effluent contains various organic and inorganic contents in different concentrations which are required by the plants. Some of the industrial effluents after certain dilution are found to be beneficial for irrigation purposes[2]. On the other side some trace elements like arsenic, cadmium, and mercury are present in sugar industry effluent which proved to be injurious to plant health[3,4].

The Hindustan Aluminum Corporation Limited was established in 1958 by the Aditya Birla Group. In 1962 the company began production in Renukoot in Uttar Pradesh making 20 thousand metric tons per year of aluminium metal and 40 thousand metric tons per year of alumina. In 1989 the company was restructured and renamed Hindalco. Heavy metals are widely used in electroplating to manufacture imitation ornaments, parts of automobiles, oven and several articles of domestic and commercial use[5]. Excessive use of above indicated heavy metals for electroplating has caused pollution of soil and water.

All concentrations of chromium used were found inhibitory to seedling growth[6,7]. The extent of inhibition increases with increasing concentration of chromium. Concentration of Nickel chloride ($1x10^{-3}$M) was inhibitory to seed germination of *H. vulgare* cv. K-125 and the effluent containing chromium (Cr) was reported inhibitory for seed germination. As such it inspired us to search out the impact of effluent of Hindalco industries on seed germination of some important leguminous crop plants.

2. Experimental

For study, uniformly selected seeds of *Cajanus cajan*, *Pisum sativum* and *Cicer arietinum* cvs. Were sterilized with 0.1% $HgCl_2$ solution and thoroughly washed with distilled water. The seeds were imbibed in different effluents collected from Site-I, Site-2, and Site-3 of Cr plating industries for their specific inhibitions period along with control sets (Seed imbibed in distilled water for their specific inhibitions period). There after seeds were washed with water and transferred to distilled water moistened filter paper in petriplates for germination in dark. Seeds were allowed to germinate at room temperature in laboratory conditions. The seeds with 2mm length of radicle were considered as germinated seeds. The inhibitions period for all the test plants was 20 hours effluents from three sites of Hindalco industry were used for the study of seed germination.

Site-1 factory effluents collected from discharge point.

Site-2 factory effluents collected from a distance of 50 m. from discharge point.

Site-3 factory effluents collected from a distance of 100 m. from discharge point.

The maximum inhibition in seed germination was found at Site-1 treated seeds whereas it was minimum, at Site-3 treated seeds. At Site-2 chemical industry effluents used, the inhibition in germination was in between the Site-1 and Site-3 treated sets. The inhibition in seed germination at

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Site- 1, Site-2, and Site-3 chemical industry effluents was ca. 25%, 15% and 1% respectively in *Cajanus cajan* cv. Bahar. ca. 30%, 25% and 2% respectively in *Cicer arietinum* cv. G-130 ca. 28%, 18% & 2% respectively in *Cicer arietinum* cv. H-208 ca. 30% 20% and 1.5% respectively in *Pisum sativum* cv. Azaad. (Table 1). Among two cultivars of *Cicer arietinum*, cv. H-208 was found to be more susceptible to chemical industry effluent toxicity than cv. G-130. In this way differential responses are shown by above stated genotypes of *Cicer arietinum* to chemical industry effluent toxicity.

Observation: Phasic pretreatment regimes of Hindalco industry effluents.

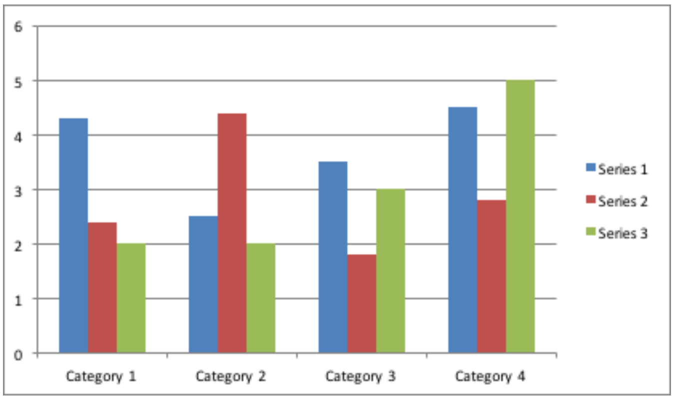

TABLE 1. Three sites of Chemical industry effluent

Cultivars	Germination (percentage inhibition)			
	Control	Site-1	Site-2	Site-3
Cajanus cajan cv. Bahar	1%	25%	15%	1%
Pisum sativum cv. Azaad	1%	30%	20%	1.5%
Cicer arietinum cv. G-130	0%	30%	25%	2%
Cicer arietinum cv. H-208	0%	28%	18%	2%

3. Results and discussion

For the study of effect of phasic pretreatment of chemical industry effluents on seed germination whole inhibition period was divided in to five equal phases (Regimes). Each phase in *Pisum sativum*, *Cajanus cajan* and *Cicer arietinum* was of 4 hours. (having the inhibitions period of 20 hours). Treatment were given to the seeds in these phases separately. While in the rest of the phases seeds were kept in distilled water. The chemical industry effluents used were from Site-1, Site-2 and Site-3. There was no significant effect on seed germination at Site-3 treated seeds, however, Site-1 chemical industry effluents were inhibitory to the germination of seeds in the above cultivars. The most interesting results recorded were that maximum inhibition in seed germination was in mid phase (Regime-3) minimum in initial phase (Regime-1). In rest of the phases inhibition in seed germination was in between the initial phase and mid phase. Thus inhibition is seed germination in regimes-1, 2, 3, 4 and 5 was ca. 10, 12, 16, 14 and 11 respectively in *Pisum sativum*. ca 12, 15, 20, 14 and 13 respectively in *Cicer arietinum* cv. G-130 ca. 13, 16, 22, 15 and 13 respectively in *Cicer arietinum* cv. G-208 (Table 1).

4. Conclusion

Hindalco chemical industry effluents used from three sites were inhibitory for seed germination for all the cultivars of the test plants. Maximum inhibition was reported at Site-1 treated seeds. In chemical industry effluents phasic treatment maximum inhibition in seed germination was in mid phase (Regime-3) minimum inhibition in seed germination in initial phase (Regime-1) in rest of the phases inhibition was in between the initial and mid phase.

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