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RESEARCH ARTICLE

INDUSTRIAL EFFLUENTS EFFECT ON SEEDLING GROWTH OF RICE AND WHEAT (ORYZA SATIVA L. AND TRITICUM VULGARE L.)

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ABSTRACT

A pot culture experiment was conducted to study the effect of industrial effluents effect on seedling growth of Rice and Wheat crop plants. The effluent samples were collected near karambaddi and Renigunta industrial area and their results have been estimated at different time intervals 10, 20 and 30th. The results showed that the application of Pharmaceutical and battery industrial effluents at 10, 20th day as resulted significantly decreased of Rice and Wheat compared with control. But the industrial effluents affected at 30th day the both plants of *Oryza sativa* L. and *Triticum vulgare* L. seedling growth of Root and Shoot (33.62 – 53.05%) and (33.77 – 41.57%) more significantly decreased compared with control. The industrial effluents effect leads to decrease the various growth parameters such as seedling growth of the root and shoot. Industrial effluents treatment should follow the treatment methods and that treated water to use and increases the soil fertility and the high yielding of crop production.

INTRODUCTION

Rapid industrialization leads to high discharge of industrial effluent which may pollute ecosystem. The Physico chemical analysis of the industrial effluent showed high alkalinity, BOD, COD and more total dissolved salts. There are many industries in and around India. Pharma and Battery industries are the most common pollutant sources in terms of both conventional and toxic parameters. Such as sulphide, chromium, Lead, Mercury, Cadmium, oil and grease, ammonia and high salinity in a range of 2000-8000 mg/l of chloride. Soil ecosystems through the world have been contaminated with heavy metals by various human activities and movement of metals uptake the food chain has become a human health hazard. The Global industries have been facing a major threat regarding the ecological problems caused by their waste stream. Environmental pollution caused by the release of a wide range of compounds as a consequence of industrialization has assumed serious proportions. Industrial effluents are responsible for serious water (Otokunefor and Obiukwu, 2005) and soil pollution (Konwar and Jha, 2010), which is considered as one of the major factors responsible for low productivity of crops. A considerable number of reports are available on the effect of different industrial effluents on different crops (Cabral *et al.*, 2010).

Effect of effluents on plant growth

Increased pollution of soils due to continuous use of heavy metal contaminated industrial effluents is critical to crop production globally and a great environmental threat. These metals accumulate in soils and plants in excess and enter food chain (Kashem and Singh, 1999; Stolt *et al.*, 2006; Jamali *et al.*, 2007). Most abundant metals in the environment with unknown metabolic functions include arsenic, mercury, Cadmium, lead and uranium are toxic to plants. Among these, cadmium (Cd) is relatively more noxious soil pollutant and its excessive discharge as a by-product from industries has worsened the situation (Mengel *et al.*, 2001). It is readily absorbed by the roots and is translocated in different parts of the shoot (Benavides *et al.*, 2005). Reduction in growth and biomass yield with increased levels of Cd arises because of altered physiological phenomenon (Demirevska-Kepova *et al.*, 2006). It causes leaf rotting and chlorosis of foliar parts, hampers leaf water status and photosynthesis (Perfus-Barbeoch *et al.*, 2002), affects ATPase activity of plasmalemma (Astolfi *et al.*, 2005), changes lipid composition by enhanced production of reactive oxygen species (Demirevska Kepova *et al.*, 2006) or decreased activities of antioxidants in a number of plant species (Agrawal and Sharma, 2006; Pal *et al.*, 2006), and within plant species which play a significant role in the expression of high tolerance in phytotoxicity (Mobin and Khan,

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2007). The plants gave better response to the treated wastewater (TW) than the groundwater. The soil receiving wastewater did not show any significant change in its physico-chemical characteristics. The soil accumulated all the heavy metals but the plant samples receiving waste water only exhibited the present of Ni, Pb and Zn whose values are far below the permissible limits. Similarly Hayat *et al*., (2002) studied the long term effect of oil refinery wastewater on crops yield, heavy metal accumulation in soil and crop produce. Results indicate that the level of nitrate, phosphate, potassium, calcium, magnesium and sulphate in wastewater is comparatively more than the ground water.

The seed yield in mustard and wheat, irrigated with waste water, was more than that with ground water Narasimha Rao *et al*., (1992) studied the quality of effluent water discharged from paper board industry and its effect on alluvial soil crops. They found that effluent water could be safely used for irrigation of rice and cotton on alluvial soil having loamy to sandy loam texture. But irrigation of tobacco and chillies with this effluent water led to poor-quality produce and reduced crop yield. Baruah *et al*., (1993) carried out a study to investigate the effect of effluent of the Paper Mill on the germination of rice (*Oryza sativa* L. *var. Masuri*) seed and subsequent growth of seedlings. The study has revealed that effluents particularly at higher concentrations inhibit germination and growth of seedlings. Further, it has been seen that rice seeds collected from effluent affected area are less viable and even the viable seeds show delayed germination in comparison to the one collected from control areas (Singh *et al.,* 2002), made the assessment of agro potentiality of the effluent coming out from Century pulp and paper mill, Ghanshyamdham, Lalkua (Uttaranchal) on wheat (*Triticum aestivum* var UP-2329) crop grown in two soils differing in texture with different effluent concentrations. Diluted effluent increased the chlorophyll content, plant height, shoot and root biomass, grain yield, protein, carbohydrate and lipid contents in wheat grains, while undiluted effluent caused inhibition in plant growth resulting in a sharp decline of yield.

MATERIALS AND METHODS

Industrial effluents, seed materials, Whatman filter paper 42, Petridish plates, Earthen Pots, Meter scale, $Hgcl_2$. Rice and Wheat seeds were obtained from N.G.Ranga Agricultural Regional Research Station Tirupati, Andhrapradesh, India.

The seeds were surface sterilized with 0.1% of $Hgcl_2$ solution for 10 min rinsed with double distilled water and kept in incubation for the seed germination. The seeds were germinated in Petri dish plates and transferred in earthen pots (30 cm x 25 cm, diameter and deep) containing red soil and Pharmaceutical and Battery industrial effluents for the seedling growth of Rice and Wheat. The pots were kept under natural photo radiation and each pot contained 30 seedlings. The pot culture of Rice and Wheat was analyzed the seedling growth of Root and shoot length for the experimental period of 30^{th} days.

RESULTS AND DISCUSSION

Morphological parameters in Rice

Root length (cm plant^{-1})

The root length of rice plants at different stages of growth under Pharma and Battery Industrial effluents are represented in **Table-1.1 and Fig-1.1**. Root lengths of rice were higher in control with increased day time intervals and decreased with the percentages of 5.84, 7.25, 11.12 an Pharmaceutical industrial effluent treatment in 10, 20, 30days time intervals. Where under Battery industrial effluents treatment 29.59% decreased root length was observed then the control and 9.28, 7. 85 and 6.16 root length were observed in10, 20, 30days of time intervals and which were 15.40 and 33.62 decreased per cent root length were observed in 20 and 30^{th} day interval time compare with control plants and which is shown in **Table-1.1 and Fig-1.1.**

Shoot length (cm plant^{-1})

The Shoot length of Rice plants at different stages of growth under Pharmaceutical and Battery Industrial effluents are represented in **Table-1.1 and Fig-1. 2**. Shoot lengths of Rice were higher in control with increased day time intervals and decreased with the per cent of 14.05, 14.73 and 29.46 in a Pharmaceutical industrial effluent treatment in 10, 20, 30days of time intervals. Where under Battery industrial effluents treatment, decreased Shoot length were observed then the control and 9.28, 7.85 and 6.16 Shoot length were observed in 10, 20, 30days of time intervals and which were 31.09 and 53.05 decreased per cent shoot length were observed in 20 and 30^{th} day interval time compared with control plant and which is shown in **Table-1.1 and Fig-1.2.**

Table1 Effect of industrial effluents on seedling growth of *Oryza sativa* L.

S.NO	Treatment	10day		20day		30day	
		Root	Shoot	Root	Shoot	Root	Shoot
1	Control (Distilled water)	13.1867 ± 0.52	16.433 ± 0.67	13.68 ± 0.59	17.05 ± 0.98	14.09 ± 0.56	17.20 ± 0.66
2	Pharmaceutical Industrial Effluent	12.418 ± 0.32 (-5.84%)	14.128 ± 0.573 (-14.05%)	11.515 ± 0.22 (-7.25%)	12.04 ± 0.48 (-14.73%)	11.036 ± 0.52 (-11.12%)	9.961 ± 0.5 (-29.46%)
3	Battery Industrial Effluent	9.281 ± 0.415 (-29.59%)	11.618 ± 0.349 (-29.33%)	7.856 ± 0.34 (-15.40%)	8.003 ± 0.45 (-31.09%)	6.16 ± 0.303 (-33.62%)	5.451 ± 0.113 (-53.05%)

Average of Six replications mean ± S.D
Per cent over control values are given in parentheses.

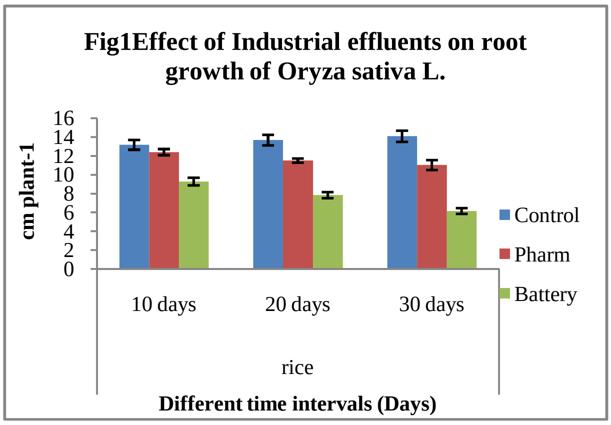

Fig1 Effect of Industrial Effluents on Root growth in *Oryza sativa* L.

Data are expressed as mean± SD.

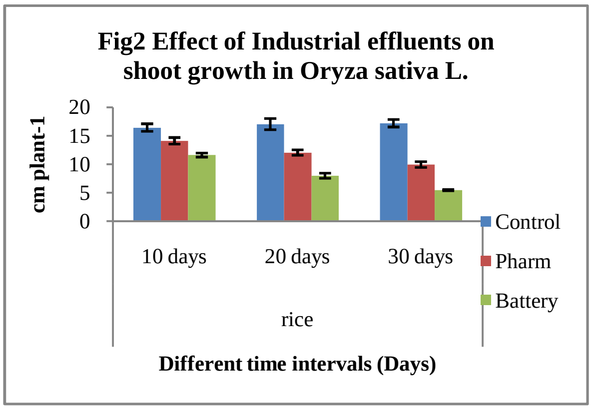

Fig2 Effect of Industrial Effluents on Shoot growth in *Oryza sativa* L.

Data are expressed as mean± SD.

Morphological parameters in *Triticum vulgare* L.

Root length (cm plant^{-1})

The Root length of Wheat plants at different stages of growth under Pharmaceutical and Battery Industrial effluents are represented in **Table-1.2 and Fig-1.3**. Root lengths of wheat were higher in control with increased day time intervals and decreased with the percentages of 16.50, 24.85 and 40.67 in a Pharmaceutical industrial effluent treatment in 10, 20, 30th days time intervals. Where under Battery industrial effluents treatment, decreased Shoot length were observed then the control and 5.46, 4.27 and 3.19 shoot length were observed in 10, 20, 30days of time intervals and which were 13.24 and 26.20 decreased per cent root length were observed in 20 and 30th day interval time compared with control plants and which is shown in **Table-1.2 and Fig-1.3.**

Shoot length (cm plant^{-1})

The Shoot length of Wheat plants at different stages of growth under Pharmaceutical and Battery Industrial effluents are represented in **Table-1.2 and Fig-1.4**. Shoot lengths of wheat were higher in control with increased day time intervals and decreased with the percentages of 8.25, 13.24 and 26.20 in a

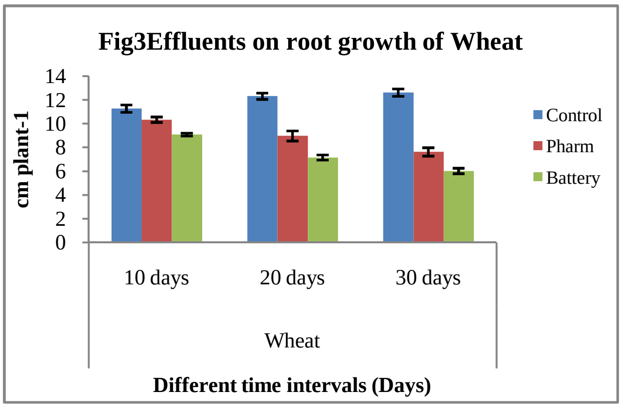

Fig 3 Effect of Industrial Effluents on Root growth in *Triticum vulgare* L.

Data are expressed as mean± SD.

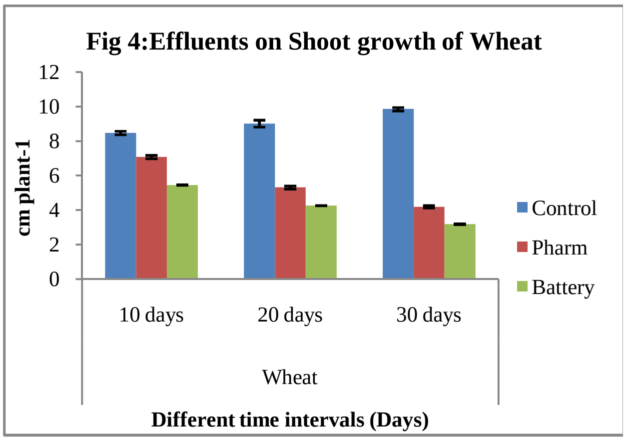

Fig4 Effect of Industrial Effluents on Shoot growth in *Triticum vulgare* L.

Data are expressed as mean± SD.

Table2 Effect industrial effluents on seedling growth of *Triticum vulgare* L.

S.NO	Treatment	10day		20day		30day	
		Root	Shoot	Root	Shoot	Root	Shoot
1	Control (Distilled water)	11.27 ± 0.31	8.483 ± 0.11	12.32 ± 0.26	9.02 ± 0.20	12.631 ± 0.31	9.86 ± 0.12
2	Pharmaceutical Industrial Effluent	10.34 ± 0.23 (-8.25%)	7.083 ± 0.45 (-16.50%)	8.97 ± 0.42 (13.24%)	5.32 ± 0.2 (-24.85%)	7.63 ± 0.354 (-26.20%)	4.20 ± 0.2 (-40.67%)
3	Battery Industrial Effluent	9.09 ± 0.12 (-19.34%)	5.46 ± 0.21 (-35.61%)	7.150 ± 0.22 (-21.34%)	4.271 ± 0.11 (-21.79%)	6.026 ± 0.23 (-33.77%)	3.191 ± 0.11 (-41.57%)

Average of Six replications mean ± S.D

Per cent over control values are given in parentheses

Pharmaceutical industrial effluent treatment in 10, 20, 30days of time intervals. Where under Battery industrial effluents treatment, decreased Shoot length were observed then the control and 9.09, 7.15 and 6.02 Shoot length were observed in 10, 20, 30days of time intervals and which were 21.79 and 41.57 decreased per cent shoot length were observed in 20 and 30th day interval time compared with control plants and which is shown in **Table-1.2 and Fig-1.4.**

DISCUSSION

The stressful conditions of the environment such as water stress, soil salinity, heat, chilling, anaerobiosis, pathogenesis, wounding, gaseous pollutants, heavy metals, etc. drastically affect plant growth and metabolism and in turn limit crop productivity. In the present day situation, the stress factors have multiplied in an exponential manner with the advent of modern agricultural and industrial practices. Heavy metal contamination of agricultural land is a widely recognized problem and studies on the harmful effects caused by heavy metals on crop plants are receiving increasing attentions (Masarovicova *et al*., 1999).

Morphological toxicity symptoms were observed at Pharmaceutical and Battery Industrial effluents treatments with different time of intervals in root and shoot tissues of Rice and Wheat (**Table-1.1-1.2**). Compared to data obtained with Pharmaceutical on the same Rice and Wheat cultivar and grown under exactly the same conditions, threshold values of tissue metal concentrations at which plant growth was significantly inhibited were **8- 40%** times higher. Metal threshold values for shoot length reduction were **19-41%** times higher respectively. These results suggest that Rice and Wheat are more tolerant to Pharmaceutical than the Battery Industrial treatments. In another Rice and Wheat cultivars, report a strong reduction in root and shoot Pharmaceutical and Battery Industrial effluents treatments with different time of intervals.
Root and shoot length of rice plants decreased with an increase in heavy metals present effluents level in the soil. Similar decrease in root and shoot length due to heavy metals were noticed by number of workers (Vijayaragavan *et al.,* 2006). Copper (Saravanan *et al.,* 2001), nickel (Vijayarengan, 2004) and also reported to reduced the growth of the plants.

CONCLUSION

The variations on growth and mineral contents of Pharmaceutical and Battery Industrial effluent treatments contaminated Rice and Wheat seedlings are not a sensitive parameter to evaluate the consequences of effluents containing heavy metals uptake. Changes on morphological parameters occurred only at the highest metal concentration studied. Moreover, the evaluation of Battery Industrial effluents induced oxidative stress using as biomarkers the enzyme activities involved in the intermediary metabolism seems to be rather indirect. The first defensive mechanism from oxidative stress is the scavenging of activated oxygen species at the sites where they are generated, especially chloroplasts where effluents containing heavy metals accumulates, and observed the influence of different kinds of industrial effluents on seed germination and seedling growth. The higher concentrations of Pharmaceutical and Battery water were found to inhibit the germination and growth of paddy (*Oryza sativa* L. and *Triticum vulgare* L.) after the treated water to increases the soil fertility and high yielding of crop production.

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Reference

Agarwal V, Sharma K. Phytotoxic effects of Cu, Zn, Cd and Pb on in-vitro regeneration and concomitant protein changes in Holarrhena antidysentrica. *Biol. Plant*. 2006;50: 307-310 .

Baruah AK, Sharma RN, Borah GC. Impact of sugar mill and distillery effluent on water quality of river Galabil, Assam. *Indian J. Environ. Health*.1993; 35: 288–293.

Benavides MP, Gallego SM, Tomaro ML. Cadmium toxicity in plants. *Braz. J. Plant Physiol.* 2005; 17: 49-55.

Cabral JR, Freitas PSL, Bertonha A, Muniz AS .Effects of wastewater from a cassava industry on soil chemistry and crop yield of lopsided oats (Avena strigosa Schreb.). *Brazilian Archives of Biology and Technology* .2010; 53:19-26.

Demirevska-Kepova K, Simova-stoilova L, Stoyanova Z, Feller U. Cadmium stress in barley: Growth, leaf pigment, and protein composition and detoxification of reactive oxygen species. *J. Plant Nutr*. 2006; 29: 451-468.

Hayat, S, Ahmad I, Azam ZM, Ahmad A, Inam Samiullah A. Effect of longterm application of oil refinery wastewater on soil health with special reference to microbiological characteristics. *Bioresource Technol.*2002; 84:159-163.

Jamali MK, Kazi TG, Arain MB, Afridi HI, Jalbani N Memon AR. Heavy metal contents of vegetables grown in soil irrigated with mixtures of wastewater and sewage sludge in Pakistan using ultrasonic-assisted pseudo-digestion. *J. Agron. Crop. Sci.*2007; 193: 218

Kashem MA, Singh BR. Heavy metal contamination of soil and vegetation in the vicinity of industries of Bangladesh. *Water Air Soil Pollut.*1999; 115: 347-361.

Konwar D, Jha DK. Response of Rice (Oryza sativa L.) to Contamination of Soil with Refinery Effluents under Natural Conditions. *Biological and Environmental Sciences*. 2010; 5(1):14-22.

Masarovicova E, Cicak A, Stefanick I. Plant responses to air pollution and heavy metal stresses. In: Pessarakli M, ed. Handbook of Plant and Crop Stress. 2nd ed. New York.Marcel Dekker.1999:569–598

Mengel K., Kirkby EA, Kosegarten H, Appel T. Principles of plant nutrition, 5th Ed., *Springer*, Heidelberg .2001.

Mobin M, Khan NA. Photosynthetic activity, pigment composition and antioxidative response of two mustard (Brassica juncea) cultivars differing in photosynthetic capacity subjected to cadmium stress. *J. Plant Physiol.* 2007;164: 601-610.

Narasimha Rao *et al*. (1992). Quality of effluent water discharged from paper board industry and its effect on alluvial soil crops. *Indian J Agri Sci*.1992; 62 (1): 9-12.

Otokunefor TV, Obiukwu C. Impact of refinery effluent on the physicochemical properties of a water body in the niger delta. *Applied ecology and environmental research*. 2005; 3(1):61-72.

Pal M, Horvath E, Janda T, Paldi E, Szalai G. Physiological changes and defence mechanisms induce by cadmium stress in maize. *J. Plant Nutr. Soil Sci.*2006;169: 239-246.

Saravanan S, Subramani A, Sundaramoorthy P, Selvaraju M, Lakshmanachary AS. Influence of copper sulphate on germination, growth and yield of soybean [*Glycine max* (L.) Merr]. *Ecol. Environ.Cons.* 2001; 7(2): 141-144.

Singh A, Agrawal SB, Rai JP, Singh P. Assessment of the pulp and paper mill effluent on growth, yield and nutrient quality of wheat. *J Environ. Biol.* 2002; 23: 283-288.

Stolt P, Asp H, Hultin S. Genetic variation in wheat cadmium accumulation on soils with different cadmium concentration. *J. Agron. Crop Sci.*2006; 192: 201-208.

Vijayaragavan M, Vijayarengan P, Manivasagaperumal R. Effect of cadmium on germination and seedling growth of radish (*Raphanus sativus* L.). *Adv. Plant Sci.* 2006; 19: 469-471.

Vijayarengan P. Growth, nodulation and dry matter yield of blackgram cultivars under nickel stress. *J. Environ.Sci. Engg.* 2004; 46(2): 151-158.

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