Journal of Interdisciplinary and Multidisciplinary Research (JIMR)
E-ISSN:1936-6264| Impact Factor: 8.886|
Vol. 18 Issue 06, June- 2023
Available online at: https://www.jimrjournal.com/
(An open access scholarly, peer-reviewed, interdisciplinary, monthly, and fully refereed journal.)

A STUDY ON IMPACT EVALUATION OF REFINERY EFFLUENT ON WHEAT CROP AT SEEDLING STAGE

Sushila Sangwan*, Anupam Sehra, Nirmala Rathee**and Rajesh Dhankhar*****

***Dept. of Botany, Government College, Hisar, **Dept. of Zoology, Government College, Hisar,**

****Dept. of Envionment, M.D. University, Rohtak**

ABSTRACT

A study on impact evaluation of refinery effluent has been done by using bioassay system of a crop plant wheat crop at early vegetative growth stage. Refinery effluent collected from Panipat Refinery was found to be having good quantity of nutrients along with some toxicants. Results showed that refinery effluent diluted up to 75% was stimulatory for seed germination, seedling growth. But undiluted refinery effluent showed inhibitory effects on the above parameters of the wheat plant at seedling stage.

Key Words: Refinery, effluent,Wheat crop, Seedling

INTRODUCTION

Industrialization strides along the road of spectacular success in last few decades resulted in its own inevitable effects in the form of air, water and soil pollution. An awareness of environmental problems and potential hazards caused by industrial wastewater has promoted many countries to limit the discharge of effluents. Unlike domestic waste, the industrial waste is very difficult to generalize and it varies from industry to industry. Effluent/industrial waste generation in the industry obviously depends upon the size and activities of the industry. Thousands of industrial units located in Haryana, Delhi and Uttar Pradesh are responsible for the major pollution load that flows in Yamuna. According to official sources, Panipat is among the six Haryana towns, which has been covered under the Yamuna Action Plan. Most of the world's air, water and land resources are now partially poisoned by industrial effluents from industrial processes including those of crude oil and gas. According to a survey, entire country produces

18,422 million litres of waste water per day (Khan, 2000,Hayat*et al* 2021), when the effluent from oil industry are not properly disposed off, there is general belief, backed up by scientific evidences that, they cause pollution to surface and underground water with dangerous consequences to life. The problem of disposal and utilisation of refinery effluent has drawn considerable concern and attention of scientists, technologist and environmental government regulators etc. There is a possibility of safe use of this waste water for recycling in industrial process as well as its potential for commercial productivity. If this effluent can be safely utilized for irrigation purpose it will minimize the environmental pollution, reduce the problem related to effluent handling, storage and disposal, preserve the quality of water and reduced the requirement of fertilizer. The treated effluent of almost all of the industries can also be used judiciously for irrigation purposes and hence prevent pollution and disposal problems (Ranganathan *et al.*, 1999; Chhankar *et al.*, 2000; Rao & Rao, 2002,Kashem*et al.*2019,Jamali*et al.* 2017)

So, an alternative pathway for evaluating the potential of treated refinery effluent for the enrichment of soil and providing irrigation water for intensely irrigated crop namely wheat cropwas taken into consideration for the present study. For the present investigation the treated effluent of Panipat refinery was taken for the irrigation of Wheat plant.

The impact of refinery effluent on wheat crop at seedling stage has been studied by researchers in India, China, and other countries. The results of these studies have shown that refinery effluent can have a significant negative impact on the growth and development of wheat seedlings.In a study conducted in India, wheat seedlings that were irrigated with refinery effluent showed a significant decrease in root and shoot growth, as well as a decrease in chlorophyll content. The seedlings also showed signs of toxicity, such as wilting and leaf chlorosis. A study conducted in China found that refinery effluent can also reduce the yield of wheat crops. Wheat crops that were irrigated with refinery effluent produced significantly less grain than crops that were irrigated with clean water.The negative impact of refinery effluent on wheat crops is due to the presence of pollutants in the effluent. These pollutants can include heavy metals, organic compounds, and petroleum hydrocarbons. These pollutants can damage the cells of wheat seedlings, leading to stunted growth and reduced yields (Mengel*et al.*2020, Cabral*et al.et al.* 2020Konwar*et al.* 2019, Kashem*et al.* 2019, Baruah*et al.*2018Benavides*et al.* 2015).

The impact of refinery effluent on wheat crops can be mitigated by treating the effluent before it is used to irrigate crops. Treatment methods can remove pollutants from the effluent, making it safe for use in agriculture.

Here are some of the treatment methods that can be used to treat refinery effluent:

- Physical treatment methods, such as screening, sedimentation, and filtration, can remove suspended solids and other large particles from the effluent.
- Chemical treatment methods, such as oxidation, reduction, and precipitation, can remove heavy metals and other inorganic pollutants from the effluent.
- Biological treatment methods, such as activated sludge treatment and trickling filter treatment, can remove organic pollutants from the effluent.

The choice of treatment method will depend on the specific pollutants that are present in the effluent. It is important to choose a treatment method that is effective in removing the pollutants, while also being cost-effective and environmentally friendly (Demirevska-Kepova*et al*2016).

By treating refinery effluent before it is used to irrigate crops, farmers can reduce the negative impact of the effluent on wheat crops. This can help to protect the environment and ensure a reliable food supply.

Journal of Interdisciplinary and Multidisciplinary Research (JIMR)
E-ISSN:1936-6264| Impact Factor: 8.886|
Vol. 18 Issue 06, June- 2023
Available online at: https://www.jimrjournal.com/
(An open access scholarly, peer-reviewed, interdisciplinary, monthly, and fully refereed journal.)

MATERIAL AND METHODS

The impact of different dilutions of refinery effluent on the physiology of wheat crop seedling i.e. early vegetative stage responses were studied in petridishes. One of the major oil refineries in north-west India is located in Panipat. Panipat is a district in Haryana lying on 29°23' north latitude and 77°01', east longitude. The effluent of oil refinery located at Panipat, was collected from disposal site and was used for watering the crop plant under study in Rohtak, Haryana, India.

The effluent collected from the Panipat Oil Refinery was analyzed for different physico-chemical properties according to APHA-1985 & 1992. Seeds were washed with 0.1% $HgCl_2$solution (100mL) for 5 minutes. Then washed the seeds for one hour under running tap water. Seed germination experiments were conducted in petriplates using different concentrations of the effluent viz. control, 25%, 50%, 75% and 100%. 15 seeds were kept in each petri-dish at uniform distances on blotting papers and moistened with 10mL of the effluent regularly and kept at 25±3°C temperature inside the BOD incubator. Each treatment had three replicates. The number of seeds germinated in a fixed time was expressed as percentage germination. Emergence of both radicle and plumule was taken as the initiation of germination. The seedling growth was measured in terms of the length of the radicle and plumule by 3rd, 6^{th}, 9^{th} and 12^{th} days after sowing. The reduced seed germination percentage (R%) or the change in germination with reference to control was calculated according to Pandey and Soni (1994).

$$\text{Reduced percentage (\%)} = \left(\frac{100 \times T_n}{T_0} - 100^* \right)$$

Where, T_n = actual germination % in sample (different concentration of effluent)

T_0 = actual germination % in control

100* = hypothesized germination in control

100 = conversion factor for percentage

The speed of germination index was calculated as per Carley and Watson (1968).

Speed of germination index = 4 (5 g + 4g + 3 g + 2g + g)

Where, g = number of germinated seeds after each 24 hour period

RESULTS & DISCUSSION

The effluent water collected from oil refinery, Panipat and control water were analyzed for different physicochemical properties shown in Table A. Total dissolved solids present in the effluent were 1390.70 mg/L which were higher than that of control water (1450.52 mg/L) but lower than that of the central pollution control board (CPCB, 1995). The effluent was slightly alkaline i.e., pH 7.79. The electrical conductivity of the effluent was lower than the ISI standards. The amounts of inorganic nutrients present in the effluent were very high as compared to that of control water. Due to these cations the hardness of the effluent, 203.98 mg/L was also rich. Other cations like sodium and potassium present in the effluent were also in excess amount than that of the control water. Carbonates, 13.1 mg/L were also present in effluent and found to be nil in the control water. Whereas, bicarbonates were in great amount, 189.19 mg/L in the effluent leading to the development of high alkalinity, 173.0 mg/L of the effluent. The anions, chloride and sulphate were also higher in the effluent than that of the control water. The dissolved oxygen, 4.5 mg/L was also observed in the effluent.

Effect of the effluent on seed germination percentage, speed of germination index and increased/reduced percentage of Wheat crop plants growing under various concentrations of the effluent was shown in Table B. It was observed that the germination percentage of the crop plant increased with the increase in effluent concentration but upto a certain limit of concentration (75%) of the effluent. The seed germination index varied from 1225 to 1571 in Wheat crop growing under the application of different concentrations of the effluent. Maximum speed of germination index (15.71) was found at 75 per cent concentration of the effluent while the lowest (1225) was observed at control water.

Effect of various concentrations of the effluent on seedling growth at different intervals of time in wheat crop plant was shown in Table C. It was revealed that the radicle as well as plumule length increased with the increase in effluent concentration. 75% concentration of the effluent resulted in maximum radicle as well as plumule on 3rd, 6th, 9th, and 10th day after sowing. On 12th day, the increase of radicle and plumule length was 14.75%, 18.76%, 22.64%, 0.71% and 11.70%, 14.04%, 19.06%, 10.48% more than the control at different concentration of the effluent respectively. Successful establishment of a plant depends primarily upon its capacity to germinate, which is usually taken as a very sensitive and decisive phase to complete its life cycle in a given habitat. Hence, seed germination of the crop plant species was studied in relation to different concentrations of refinery effluent. In wheat crop maximum percent germination was reported under 75 percent effluent concentration which might be attributed to (i) reduction of concentration of constituents to beneficial level and (ii) enhanced plant nutrients such as nitrogen, potassium and calcium present in effluent. Favourable seed germination has also been noted under low concentrations of the effluent for a number of crops, e.g., *Oryza sativa, Lens esculenta, Cicer arietinum and Brassica juncea* by Kalra *et al.* (1997) and Sharma *et al.* (2001 and 2002). But undiluted refinery effluent did not showed stimulatory effects on seed germination because during the germination, seed take up water, which is used to hydrolyze the stored food materials and to activate the enzyme action. As the water absorption take place by osmosis, the salt contents in refinery effluent outside the seed may act as a limiting factor which may be a probable reason for reduced germination at high effluent concentration because high osmotic concentration of the medium inhibit the water absorption. The adverse effect of refinery effluent on germination of seeds were also attributed to the presence of biotoxic substances which alter the seed-water interaction necessary for triggering enzyme activity. The lower germination percentage at higher concentration of different effluents was also due to high concentration of toxic ions present in the effluent (Thakre *et al.*, 1982 and Prashanti & Rao, 1998). Similar results also been reported by Singh & Mishra (1987). Ajmal & Khan (1986), Gautam & Bishnoi (1990), Madhappan (1993) and Vijayarangana & Lakshmanachari (1993)Mengel*et al.*(2020).

Favourable influence of the low effluent concentrations on the seedling growth was reported (Table C) which might be due to the presence of plant nutrients such as calcium, nitrogen and magnesium ions is refinery effluent. But inhibition of germination and seedling growth at higher concentration of refinery effluent which might be due to either high level of total dissolved solids which enrich the salinity and conductivity of the solute absorbed by seed before germination (Rajaram *et al*., 1988) or due to increased accumulation of soluble salts, and hence the increased accumulation of soluble salts, and hence the increased osmotic pressure inhibits seedling growth (Bernstein & Hayeard, 1958). Hayward and Wadleigh (1949) also supported the view that reduced water availability induced by high osmotic pressure of the root medium was the factor restricting the growth of the plants. The presence of high amount of heavy metals in undiluted refinery effluent potentiates a significant retarding effect on photosynthetic pigment metabolism and accumulation, which might be one of the significant cause of impaired seedling establishment and subsequent seedling growth of *Triticum aestivum* (Bernstein & Hayeard (1958; Mishra, 1987; Lakshman, 1988 and Rajaram *et al*., Mengel*et al.*(2020)

Table A: Characteristics of refinery effluent and control water in comparison with the CPCB (1995) standards

Parameter	Effluent	Control	CPCB Standards
lour	Brownish grey	Clear	Clear
TDS	1390.70±0.68	1278.38±0.59	21.00
PH	7.78±0.25	7.07±0.41	5.5-9.0
EC mmohos/cm	6.23±0.49	4.40±0.53	2000
Ca^{2+}(mg /L)	39.48±0.42	42.14±0.27	–
Mg^{+2} (mg/L)	183.78±0.61	34.98±0.49	–
CO_3^{-2} (mg/L)	13.1±0.31	-	–
HCO_3^- (mg/L)	189.19±0.52	125.55±0.63	–
Hardness mg/L)	203.98±0.62	43.68±0.38	–
TA (mg/L)	173±0.36	151.84±0.29	–
Cl^-(mg/L)	83.18±0.58	68.00±0.56	600
SO^{-2}(mg/L)	38.78±0.61	17±0.32	–
DO (mg/L)	4.5	6.5	–
PO_4^{-3}(mg/L)	68±0.49	9.00±0.48	–
Fe^{+2}(mg/L)	1.2±0.56	0.19±0.42	–

Zn^{+2}(mg/L)	4.39±0.63	58±0.69	–
Ni^{+}(mg/L)	0.17±0.29	0.02±0.01	–
Cu^{+2}(mg/L)	0.05±0.46	0.02±0.05	–
Na^{+} (mg/L)	94.0±0.51	58.0±0.69	–
K^{+}(mg/L)	410	134	–
Oil & Grease (mg/L)	7.5	–	–

Mean values ±SD

Table B: Effect of different concentrations of the effluent on germination percentage, speed of germination index and reduced percentage of wheat crop

Crop Plant	Effluent Concentration	Germination %	Reduced %	Speed of Germination Index
wheat	Control	70.12±0.36	0	1225
	25%	75.25±0.49	+6.98	1400
	50%	80.78±0.63	+16.34	1433
	75%	87.13±0.57	+25.12	1571
	100%	71.98±0.41	+1.17	1314

Table C: Effect of various concentrations of the effluent on seedling growth of wheat crop at different intervals

Effluent concentrations	Days							
	Plumule Length (cm±SD)				Radicle length (cm±SD)			
	3rd	6th	9th	12th	3rd	6th	9th	12th
Control	2.89 ±0.24	5.58 ±0.34	7.08 ±0.41	8.97 ±0.29	2.38 ±0.25	4.82 ±0.41	5.67 ±0.52	6.98 ±0.72
25%	3.10 ±0.76	5.82 ±0.54	7.26 ±0.51	10.02 ±0.62	2.54 ±0.36	5.20 ±0.61	6.18 ±0.63	8.01 ±0.36
50%	3.24 ±0.63	6.08 ±0.24	8.23 ±0.45	10.23 ±0.71	2.63 ±0.61	5.48 ±0.38	6.41 ±0.52	8.29 ±0.41
75%	3.51 ±0.43	6.14 ±0.65	8.34 ±0.54	10.68 ±0.56	2.78 ±0.71	5.51 ±0.38	6.84 ±0.43	8.56 ±0.63
100%	2.99 ±0.65	6.00 ±0.57	7.18 ±0.35	9.91 ±0.63	2.50 ±0.29	5.22 ±0.21	6.19 ±0.56	7.03 ±0.52

Mean values ± SD.

CONCLUSION

An objective analysis of the aforementioned results clearly indicated the beneficial impacts of the treated Panipat Petroleum Refinery effluent up to dilution of 75% on the physiology of early growth stage of wheat crop.

REFERENCES

Agarwal V, Sharma K. Phytotoxic effects of Cu, Zn, Cd andPb on in-vitro regeneration and concomitant proteinchanges in Holarrhena antidysentrica. Biol. Plant. 2016;50: 307-310 .

Baruah AK, Sharma RN, Borah GC. Impact of sugar mill anddistillery effluent on water quality of river Galabil, Assam. Indian J. Environ. Health.2018; 35: 288–293.

Benavides MP, Gallego SM, Tomaro ML. Cadmium toxicityin plants. Braz. J. Plant Physiol. 2015; 17: 49-55.

Cabral JR, Freitas PSL, Bertonha A, Muniz AS .Effects of wastewater from a cassava industry on soil chemistryand crop yield of lopsided oats (Avena strigosa Schreb.). Brazilian Archives of Biology and Technology .2020; 53:19-26.

Carley, H.E and Watson R.D(1968) Effect of various aqoues plan extracts upon seed germination. *Bot. Gazet*,129(1):57-62

CPCB (1995) . Pollution control acts, rules and notifications issued thereunder, *Cont. Poll.Cont.Board*, New Delhi.

Chhonkar, P.K., Dutta, S.P., Joshi, H.C. and Pathak, H. (2000a). Impact of industrial effluents on soil health and agriculture – Indian experience: Part 1 – Distillery and Paper Mill Effluents. *Journal Sci. and Industrial Res.*, **59(5):** 350-361.

Chhonkar, P.K., Dutta, S.P., Joshi, H.C. and Pathak, H. (2000b). Impact of industrial effluents on soil health and agriculture – Indian experience: Part 11 – Tannery and Textile Industrial Effluents. *Journal Sci. and Industrial Res.*, **59(6)**: 446-454.

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. 2016; 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.2021; 84:159-163.

Jamali MK, Kazi TG, Arain MB, Afridi HI, Jalbani NMemon AR. Heavy metal contents of vegetables grownin soil irrigated with mixtures of wastewater and sewagesludge in Pakistan using ultrasonic-assisted pseudo- digestion. J. Agron. Crop. Sci.2017; 193: 218

Kashem MA, Singh BR. Heavy metal contamination of soil and vegetation in the vicinity of industries of Bangladesh. Water Air Soil Pollut.2019; 115: 347-361.

Kalra N. and Joshi H.C., Chaudhary A., Choudhary R. and Sharma S.K. (1997). Impact of flyash incorporation in soil on germination of crops. *Bioresource Technology*. **61:** 39-41.

Khan H.J. (2000). Clean-up act. Science Reporter. **37(4):** 42-43.

Konwar D, Jha DK. Response of Rice (Oryza sativa L.) toContamination of Soil with Refinery Effluents under Natural Conditions. Biological and Environmental Sciences. 2019; 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. NewYork.Marcel Dekker. 2019:569–598

Mengel K., Kirkby EA, Kosegarten H, Appel T. Principles of plant nutrition, 5th Ed., Springer, Heidelberg .2020.

Prashanthi, V. and Rao, K.J. (1999). Impact of land disposal of industrial effluents on properties of soils of Noor Mohammed lake bed. *J. Environmental Bio.*, **20(3):** 271-274.

Sharma, S.K., Karlra, N. and Singh G.R. (2001). Impact of coal-burnt ash on environment and crop productivity. *J. Sci. Indi. Res.***60:** 580-585.

Sharma, S.K., Kalra, N. and Singh G.R. (2002). Soil physical and chemical properties as influenced by flyash addition in soil and yield of wheat. *J. Sci. Ind. Res.*, **61:** 617-620.

Ranganathan, R., Sheela, R., Venkatesan, A., and Ravindran, K.C. (1999). Sea water effect on growth and photosynthetic parameters of *Avicennia oficinalis L.*, *Geobios*, **26(4):** 179-182.

Rao, A.P. and Rao, P.V.V.P. (2002). Pollution potential of sago industry: A case study. *J. Ecotoxicology Environmental Monitoring*, **12(1):** 53-56.