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Research Article

Studies on Groundwater Pollution of Rural Areas Located Near Kali River and its Effect on Chlorophyll and Protein Content of *Triticum aestivum*

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Abstract

Present research work was conducted to evaluate the physico-chemical properties of groundwater and its effect on wheat crop plant. Samples were collected from different sites situated near the Kali River of Meerut region. The goal of the current study is to comprehend how *Triticum aestivum* biochemical components are affected by groundwater pollution. Various parameters such as Biochemical oxygen demand (BOD), Chemical oxygen demand (COD), Dissolved oxygen (DO), Calcium, Chloride, Sodium and biochemical parameters such as chlorophyll a, chlorophyll b, total chlorophyll and protein content were observed in this study. Numerous variances were observed in the current analysis. The groundwater contamination severally affects crop plants when used for irrigation. Water samples of different sites showed the values of DO 0.65 to 0.5 mg/l, BOD 4.8 to 2.4 mg/l, COD 13.3 to 38.6 mg/l and chloride 83.89 to 137.07 mg/l, calcium 0.32 to 1.69 mg/l, sodium 108 to 248 mg/l, sulphate 0.03 to 0.40 mg/l and biochemical analysis of wheat crop showed the values of protein 1.64 to3.44 mg/gf.wt, chlorophyll a 0.16 to 0.37 mg/gf.wt, chlorophyll b 0.13 to 0.24 mg/gf.wt, total chlorophyll 0.41 to 0.55 mg/gf.wt. The study concluded that the groundwater around the Kali River in five separate places (villages) of Meerut district is not safe for irrigation and drinking purposes on the basis of most measures, however its suitability for irrigation is questioned on the basis of a few considerations.

Keywords: *Groundwater, contamination, BOD and Kali River.*

Introduction

Groundwater is the major source of fresh water in arid and semiarid regions. Principally it is used for irrigation, domestic and industrial purposes. The fast rate of industrialization in India has changed the substance of city environment and conducts its wake issues of ground water pollution put at risk human beings. According to WHO association, around 80% of all the sickness in people is caused by water. In the environment, water is seen as a valuable resource (M. Ilyas, *et al*., 2017 and S. Yousaf, *et al*., 2020). Life is impossible for living things without water, which is a necessary component of all living things. It is largely used for drinking, with 65% of the global population drinking from it, 20% used for irrigation, and 15% used by the industrial sector (Adimalla, *et al*., 2018).

Planning for long-term control of crop yields requires evaluation of irrigation water quality because high electrical conductivity of water (EC) prevents plants from competing with ions in the soil solution (Bauder, *et al*., 2011). Groundwater and surface water (lakes, ponds, and rivers) are both widely used for irrigation around the world. Because it is more readily available than surface water, subsurface water is preferred for irrigation purposes all over the world. Crop water intake, salt content, crop sensitivity, soil features, agricultural characteristics, and irrigation water quality are some of the other variables that affect crop

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yield loss (Foth, 1990). Plants become toxic as a result of soil-borne accumulations of sodium, chloride, and boron in the leaves and other plant parts. The crops may be affected separately or all at once by these harmful ions. During spray irrigation in the hot, dry summer, the harmful ions in plants are further increased. The hazardous ions can also be absorbed by plants through their leaves. In order to evaluate agricultural yields, it is therefore crucial to evaluate irrigation water quality (Suarez, 2012).

Effluents from many industries are discarded into open pits or unlined channels with practically no treatment which contaminate ground water sources. The factory waste water, sewage, slop and rigid waste are additionally released into the channels. These materials enter springs and make drinking water contaminated. Meerut city needs sewage treatment plant. Ordinarily around 150 tons trash stays uncollected on the road and there is no administration for the collected hard waste. In a large portion of the area sewage is released into drains with practically no treatment. These channels release both domestic and factory waste water from thickly populated city regions and eventually join River Kali. Polluted lane water is also depleted into River kali streaming on the eastern side.

These days, because of fast developing urbanization, the nature of land water is being decayed by stirring up of industrial waste and homegrown sewage in our streams (Abida, *et al*., 2009). Particularly in urban regions, the reckless removal of industrial effluents and different squanders contributes incredibly to the contamination of the water (Islam, *et al*., 2010). A review on the effect of industrial effluents on water nature of kali River in Meerut district (India) was completed which showed physio-chemical variables over as far as possible (Yadav, *et al*., 2011). The greater part of the Rivers streaming in urban regions are toward the end point of effluent release and on the off chance that not treated and appropriately controlled can also contaminate the groundwater (Moscow, *et al*., 2011).

Triticum aestivum (family:Poaceae) var. HD-3059 most likely came from the fertile crescent in the region running from Armenia to Iran's south-western Caspian Sea coast. One of the most significant crops used as a staple meal for humans is wheat (Triticum spp.), which accounts for around 20% of the protein and calories in food consumed globally. The wheat plant is a 0.4–1.2 m tall, heavily tufted annual grass with 2–40 tillers per plant. Size, inflorescence, and grain morphology are all highly diverse, depending on the species, variety, and cultivar, each of which is adapted to certain growth circumstances or uses. Seminal roots and adventitious roots are both part of the root system. Culms are cylindrical, glabrous, upright, and have solid nodes and hollow internodes. The leaves are flat and 20–38 cm length by 1-3 cm wide. With each leaf insertion on the culm, the leaf size grows. The inflorescence is a tall, slender spike that has a slight flattening. The seed is an elliptical caryopsis with ventral grooves and is available in reddish-brown, yellow, or white (Ecocrop, 2011).

It was seen that during the most recent couple of year’s groundwater of Meerut district and its nearby rustic region just as Kali River becomes contaminated. Subsequently, the current investigation is focused over to discover the physiochemical properties of mentioned regions.

Material and Methods

Sample Collection and Analysis

For the present study *Triticum aestivum* var. HD-3059 is used as experimental materials. Water samples were collected in October, 2018 to estimate of the physiochemical properties. Five handpump water samples were collected from the different rural areas of Meerut district i.e. Bhawanpur (BW), Gokulpur (GP), Dedwa (DV), Saini (SN) and Ulakhpur (UP) situated near the Kali River. Samples were collected in the plastic containers. Before sampling, the handpump was constantly siphoned for 5 minutes to limit the impact of static water in the groundwater. All bottles were washed multiple times completely with the water to be sampled.

All these water samples were analyzed for physiochemical properties using different standard techniques, i.e., BOD, COD, DO, chloride, calcium, sodium, sulphate and its effect on protein and chlorophyll content of Triticum aestivum (var. HD-3059) crop plant. The all test were conducted in the laboratory of Department of Botany, C.C.S. University, Meerut.

Physio-chemical Analysis of Groundwater Samples

Calcium Content

Calcium was estimated by Versenate EDTA method. 5 ml of water sample was taken in the conical flask and added sodium hydroxide solution. Then, added a pinched of Eriochrome Black T indicator. At that point, titrated with EDTA solution till the color slowly changes from pink to reddish violet color. After 5 seconds readings were recorded.

Chloride Content

Chloride was calculated by Argentometric method. 100 ml of water sample was taken in the conical flask and added potassium chromate as an indicator. After that, titrated against a standard silver nitrate solution until a reddish color was obtained. Then readings were recorded.

Dissolved Oxygen (DO)

Dissolved oxygen (DO) was measured by Winkler's iodometric method. 300 ml of water sample was taken in the BOD bottle and added mangnous sulfate, alkali iodine-azide mixture to the sample. Then, added sulphuric acid and mixed well to dissolve the solid. Then 50 ml sample was taken in conical flask and titrate with sodium thiosulphate solution till the presence of pale yellow color. Then, starch indicator was added which changes the color to blue and titrated again with sodium thiosulphate mixture till the vanishing of blue color. The readings were recorded.

Biochemical Oxygen Demand (BOD)

Biochemical oxygen demand (BOD) was estimated by Winkler's iodometric method. Filled water sample of each in two BOD bottles and added allylthiourea. Then, added mangnous sulfate and alkali iodide-azide mixture in one of two bottles. Put one bottle into the incubator and save them at 27 ^{0}C for 5 days and then dissolved oxygen fixation was measured. After that, sulphuric acid was added and mixed well to dissolve the solid particles. Then, 50 ml of water was taken and titrate with sodium thiosulphate solution till the presence of light yellow colour. At that point, starch marker was added which changes the colour to blue and titrate again with sodium thiosulphate mixture till the vanishing of blue colour. Then, readings were noted.

Chemical Oxygen Demand (COD)

Chemical oxygen demand (COD) was estimated by the titrimetric method. 25 ml of water was taken in flask and added potassium dichromate mixture, a pinched of silver sulfate, mercuric sulfate and sulphuric acid mixture, shaken it well and connect leibig's condensor to the mouth of flask and heat the flask on hot water bath for minimum 2 hours and cool it and dilute the substance with distilled water. Then, added ferroin marker was added and titrated with ferrous ammonium sulphate solution. The colour changed was changed from blue green to reddish blue brown colored and then, readings were recorded.

Sodium Content

Sodium was measured by flame photometer. Calibrate the instruments with the standards and gauge the sodium ppm in the samples.

Sulphate Content

Sulphate was estimated by Chesin and Yien, 1950 method. For this, water sample were taken in flask and activated charcoal was added. Samples were shaken on mechanical shaker for 30 minutes and separated them. Then, added barium chloride and gum acasia to the water sample. After 30 minutes, the absorbance was recorded at 440 nm subsequent to adjusting the instrument by drawing standard curve.

Biochemical Analysis of Triticum Aestivum

Estimation of Chlorophyll Content

Fresh leaf tissue was separated in 80% CH3)2CO (v/v) for the purpose of determining the amount of chlorophyll, and the supernatant was spin at 5000 rpm.

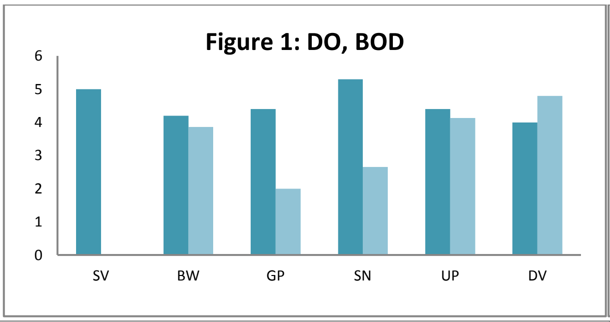
Shimadzu UV-2600 spectrophotometer was used to measure the absorbance of the supernatant at 663, 645, and 436 nm **(Arnon, 1949).**

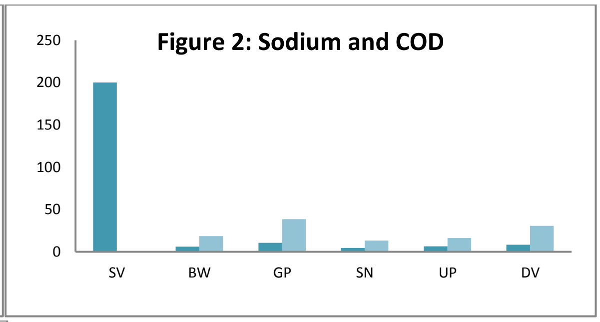
Estimation of Protein Content

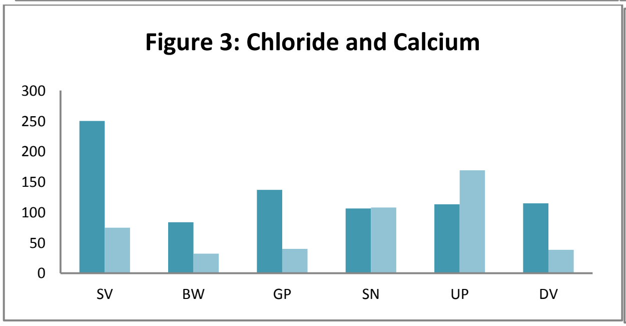
200 mg of fresh leaf tissue were homogenised in 5.0 ml of Tris HCl solution (pH 7.0) and centrifuged at 10,000 rpm for 10 minutes to determine the amount of protein present. 5.0 ml of Coomassie brilliant blue dye was applied to 1.0 ml of sample extract, and a reading was taken at 595 nm **(Bradford, 1976).**

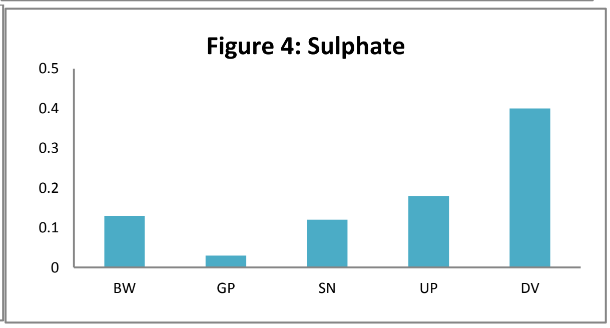
Result and Discussion

The physiochemical data were first statistically investigated to show the overall attributes of groundwater. These outcomes were contrasted with the standard value given by Bureau of Indian Standards (BIS).

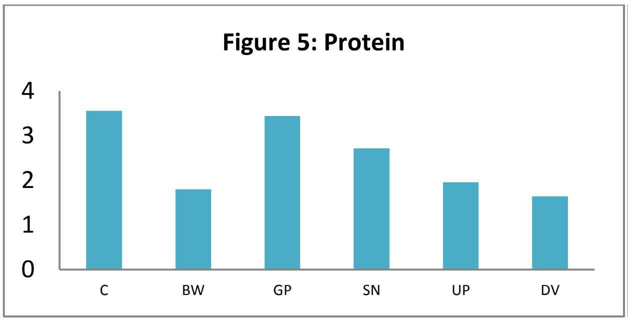








Figures 1 to 4: Physio-chemical analysis of groundwater samples



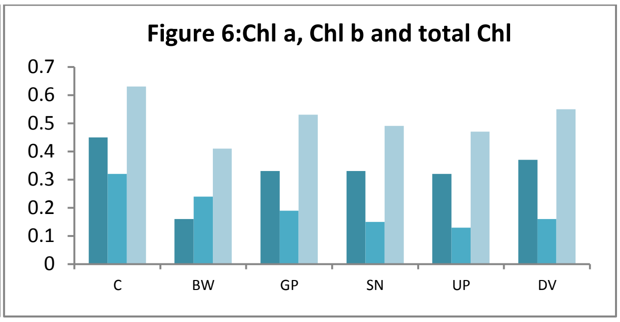


Figure 5 to 6: Rise and fall in biochemical attributes of seedlings of T. aestivum with different groundwater treatments

The source of calcium and magnesium in natural water are various types of rocks, industrial waste and sewage (Trivedy and Goel, 1984).The calcium appears in water normally. The calcium content in the groundwater sample was observed in the range of 32 and 169.33 mg/l. The highest amount was observed in Ulakhpur site and minimum value was observed in Bhawanpur site than the prescribed limit 75 mg/L, given by BIS. The Chloride value of groundwater samples was observed between 83.89 to 137.07 mg/l. The most minimal chloride content 83.89 mg/l was found in Bhawanpur site, while highest value 137. 07 mg/l was observed in Gokulpur site. All samples sites showed lowest values than the prescribed limit of 250 mg/l given by BIS. The sodium content of was observed between 108 to 248 mg/l. The highest value of sodium content

248mg/l was found in Gokulpur site than the prescribed limit 200 mg/l given by BIS, while Saini site showed lowest value 108 mg/l of sodium content. The Dissolved Oxygen (DO) of the groundwater samples was observed in between 4 to 5.3 mg/lit. Saini site showed highest value 5.3 mg/l than the prescribed limit 5.0 mg/l given by BIS, while Dedwa site showed lowest value 4 mg/l. Chemical oxygen demand (COD) of the samples was reported between 13.3 to 38.6 mg/l. The highest value 38.6 mg/l was found in Gokulpur site, although Saini site showed lowest value 13.3 mg/l. BOD is a marker parameter to know the appearance of biodegradable matter in discharge and express level of pollution. Biochemical oxygen demand (BOD) of the study area varies from 2 to 4.8 mg/l. Dedwa site showed maximum value 4.8 mg/l, while the most reduced value 2 mg/l of BOD was seen at Gokulpur site. Same result was reported by A.M. Shaikh P.N. Mandre (August, 2009) explored physico-chemical boundaries of portable water Khed (Lote) factory area. The TDS of water sample went from 300 to 685 mg/L. The chloride tracked down in the reach 60 to 250 mg/L. In concentrated on water sample alkalinity tracked down in range 120 to 360 mg/L. DO found in water sample in the reach 3.9 to 7.8 mg/L. The BOD value of groundwater samples were between 0.44 to 2.00 mg/L. Water sample hardness goes from 100 to 750 mg/L. The sulphate content of the samples was found in between 0.03 to 0.40 mg/l. The most minimal sulphate content 0.03 mg/l was found in Gokulpur site, while most maximum sulphate content 0.40 mg/l was found in Dedwa site. All the water samples are within the desirable limit 200mg/l prescribed by BIS. D Freeda Ganana Rani, (2007) also reported physico-chemical properties of Groundwater of Thirumanur region, Tamil Nadu (India). Chloride content of groundwater samples of the study regions ranges from 36 to 600 mg/L, sulphate was found from10 mg/L to 239 mg/L. Alkalinity of groundwater samples of the study regions goes from 164 to 480 mg/L. Nitrate of the study regions goes from 6 mg/L to 155 mg/L. Nitrite of the review regions goes from 0.0 mg/L to 0.40 mg/L.

Total chlorophyll concentration ranged from 0.41 to 0.55 mg/gf.wt. Chlorophyll a levels ranged from 0.16 to 0.33 mg/gf.wt. In comparison to the control (0.63 mg/gf.wt), the Dedva treatment had the highest level of total chlorophyll and chlorophyll a, while the Bhawanpur treatment had the lowest level. Chlorophyll b values were from 0.13 to 0.24 mg/gf.wt. When compared to the control, the maximum amount was observed in the Bhawanpur treatment while the lowest amount was observed in the Ulakhpur groundwater treatment. The chlorophyll content of control crop plants is higher. Total protein levels in treated crops ranged from 1.64 to 3.44 mg/gf.wt. When compared to the control, the Gokulpur groundwater treatment had the highest protein content while the Dedva treatment had the lowest. It could be attributed to chlorophyll breakdown during stress or chlorophyll biosynthesis suppression. According to research, stress causes a decrease in protein concentration in plants (Rong Guo, *et al*., 2007; Hsu & Kao 2003).

Conclusion

In the present study the groundwater contamination around the Kali River was studied. It was found that groundwater in the research area has been polluted, particularly by BOD and COD contamination. For many decades, excessive groundwater exploitation and indiscriminate use of agricultural chemicals have been carried out to secure food security through extensive wheat and pulse cultivation. It is possible to conclude that groundwater samples around the Kali River inhibited the crop growth. The study concluded that the groundwater around the Kali River in five different locations (villages) of Meerut district is not safe for irrigation purposes on the basis of most parameters, although its appropriateness for irrigation is doubtful on the basis of a few factors.

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