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# Effect of wastewater irrigation on the crop growth and fungal disease intensity on fennel (*Foeniculum vulgare* Mill.) in district Bareilly, Uttar Pradesh, India

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## ABSTRACT

During the investigation it was observed that wastewater regularly (WWR) used for irrigation of crop show adverse effect on plants growth and yield, thus significantly increased the disease intensity as compared to occasionally used waste water (WWO) and ground water (GW). WWR suppressed the growth of fennel plant and showed highest increase in disease intensity but the yield of crop was decreased gradually. The highest disease intensity was observed in Fusarium wilt disease caused by Fusarium sp. followed by stem gall. WWO showed the moderate (++) plant growth in comparison to normal growth of plants irrigated with GW and suppressed growth of crop irrigated by WWR. The WWO increased the total yield of crop followed by GW and showed the slightly decreased disease intensity except Fusarium wilt due to their composition of minerals which is necessary for plant growth. The study reveals that the high quantity of inorganic minerals was presented in WW followed by soil and GW respectively. The regular irrigation of crop by WWR showed the high accumulation of soil toxins and inorganic minerals in the field caused high disease intensity and poor growth yield of fennel crop as compared to irrigation by WWO and GW.

## 1) INTRODUCTION

India is leading country in context of area covered in fennel production. Fennel belongs to family apiaceae. Fennel is widely grown as cash crop for its fruit in India. District Bareilly of Rohikhand region contribute a large fennel production area as compared to districts viz. Rampur, Pilibhit, Badaun and Shahjahanpur etc. but like many other crops fennel attacked by a large number of pathogen viz. *Prptomyces macrosporus, Alternaria tenuis* etc. (Patel et.al.2008).

River Ramganga, is a tributary of Ganga, flows in the district Bareilly is the main source of irrigation of crops. Untreated effluents and sewage generally discharged into the river from a number of industries. During the survey (2011-2013) it was observed that due greater demand of irrigation water the farmers have no other option left to grow their crops with waste water irrigation due to its easy availability. Soil contamination by sewage and industrial effluent has affected adversely both the soil health and crop productivity.

Waste water is the source of both beneficial and harmful elements viz. plant nutrients and heavy metals viz. Cd, Ni and Hg etc. (Narwal et.al.1993). Continuous use of waste water in fennel field has resulted in soil sickness, accumulation of toxic metals in soil and showed significant increase in disease intensity and reduction in plant growth. The present study discus the effect of waste water on the growth, production and disease causing pathogens of fennel.

## 2) MATERIALS AND METHODS

Effect of waste water on fennel production, growth and disease intensity of pathogens were observed in fields during surveys of 2011-2013. Physio-chemical data of soil, ground water and waste water were recorded using standard protocols (APHA-2010). Harvest yield parameters like umbel length, number and seeds numbers were also noted at different picking stage of crop.

Disease intensity was calculated according to Wheeler (1969).

$$\text{Disease intensity (\%)} = \frac{\text{Sum of all the disease ratings}}{\text{Total no.of plants/plant parts assessed}} \times \frac{100}{\text{max.observed grade}} \quad (5)$$

The intensity of all diseases except stem gall was measured by counting the number of affected plants and healthy plants in a definite area at different places in the field. Quadrates of 1m X 1m size were used for this purpose. Disease intensity for stem gall was calculated on per plant infection basis because of its fewer incidences. For this purpose at least 100 diseased plants were observed and intensity score was calculated on the basis of concentration of galls on different parts as done by Gupta (1954) in case of stem galls on coriander.

Overall disease intensity (%) was calculated by averaging the disease intensity obtained from each field. The analysis and interpretation of all data of the crop were analysed using

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appropriate statistical analysis.

## 3) RESULTS AND DISCUSSION

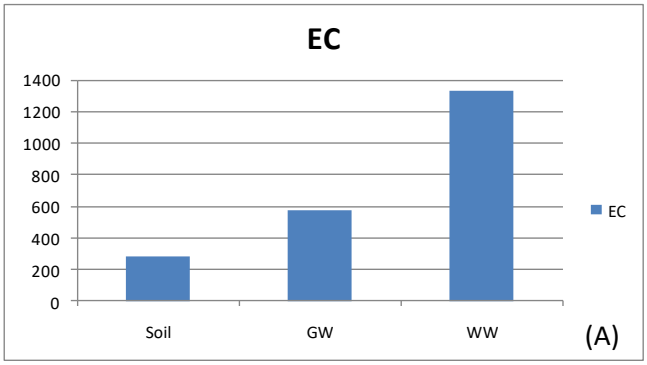
Samples of experimental soil, ground water and wastewater used for the fennel crop production were analysed using standard methods. Wastewater has great potential for the reuse as the source of water, nutrients and soil conditioning agent. Wastewater had an average of EC, pH, TS etc., which are with in permissible limits of guidelines for irrigation water quality (Table-1). Wastewater was alkaline with the pH of 8.3 and average EC (1330 mhos $cm^{-1}$). EC is widely used as a reliable indicator of the salinity of soils. The wastewater has considerably higher BOD and COD then ground water, it determines the pollution power of wastewater in the term of oxygen that microorganism would require for complete stabilization. Wastewater has high amount of inorganic minerals compared to soil and ground water.

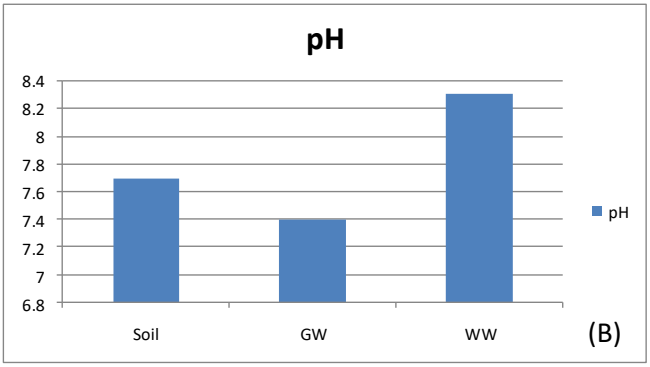
**Table 1**: Physico-chemical characteristics of soil, ground water (GW) and waste water (WW) noticed during survey of fennel growing fields.

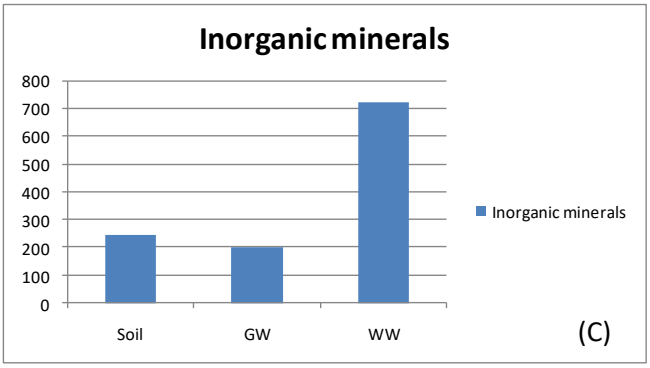
| S.No. | Determints | Soil | GW | WW |
|---|---|---|---|---|
| 1 | Texture | Sandy loam | - | - |
| 2 | Colour | Blackish brown | Colourless | Lightly black |
| 3 | EC | 285 | 572 | 1330 |
| 4 | pH | 7.69 | 7.4 | 8.3 |
| 5 | Inorganic minerals | 247 | 202.07 | 719.99 |
| 6 | TDS | 768 | 582 | 1421 |
| 7 | BOD | - | 17.07 | 155 |
| 8 | COD | - | 38.2 | 362 |

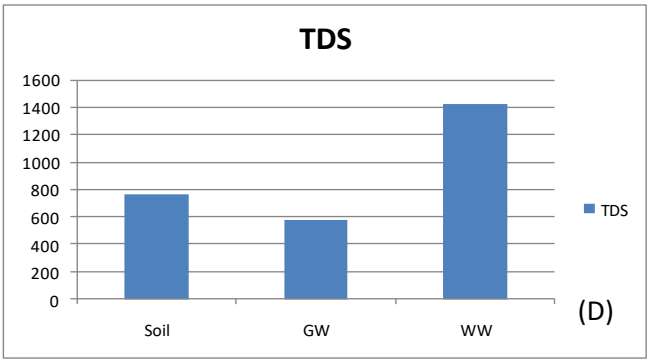
**Table 2**: Effect of different irrigation type on fennel plant growth, seed yield and disease intensity of different diseases

| S. No. | Diseases | Irrigation type | Plant growth | Disease intensity (%) | Seed yield (Kg/h) |
|---|---|---|---|---|---|
| 1 | Stem-gall | GW | + | 36 | 526 |
| | | WWO | ++ | 26 | 728 |
| | | WWR | - | 58 | 402 |
| 2 | Alternaria blight | GW | + | 24 | 620 |
| | | WWO | ++ | 19 | 682 |
| | | WWR | - | 25 | 580 |
| 3 | Cercospora blight | GW | + | 19 | 482 |
| | | WWO | ++ | 23 | 681 |
| | | WWR | - | 29 | 519 |
| 4 | Fusarium wilt | GW | + | 14 | 840 |
| | | WWO | ++ | 19 | 625 |
| | | WWR | - | 62 | 201 |



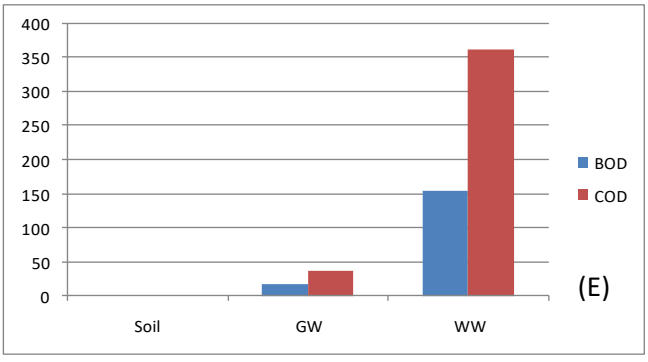




**Figure A-E** - EC, pH, Inorganic Minerals, Total Dissolved Solids (TDS), Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) of samples.

Table-2 indicates that WWR suppressed the growth of fennel plant and showed maximum increase in disease intensity (%) thus the yield of crop was decreased gradually. The highest disease intensity was observed (62%) in Fusarium wilt disease followed by stem gall (58%). WWO showed the moderate (++) plant growth in comparison to normal growth of plants irrigated with GW and suppressed growth of crop irrigated by WWR. The WWO increase the total yield of crop followed by GW and showed slightly decreased intensity in disease intensity except in the case of Fusarium wilt disease due to their composition of minerals which is necessary for plant growth.

The study reveals that the high quantity of inorganic minerals (719.99) was presented in WW followed by soil (247) and GW (202.07) respectively. The regular irrigation of crop by WWR showed the high accumulation of soil toxins and inorganic minerals in the field caused high disease intensity and poor growth yield of fennel crop as compared to irrigation by WWO and GW.

## 4) CONCLUSION

Wastewater is a rich source of inorganic nutrients which are essential for the growth and development of plants thus reuse of wastewater for irrigation purpose will be beneficial and this practice led to safe disposal and prevent environmental pollution. But the regular use of wastewater in the fennel growing field suppressed the growth of plants and decreased the plant yield while the occasionally used wastewater was more pronounced.

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