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# Effect of Distillery Industry Effluent on Fertility of Soil and Crops

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**Industries effluents are the major source of water pollution, which disturb the life cycle of the living thing on Earth. The physicochemical parameters of the some industry are very high which affect not only the crop growth but decreases the fertility of the soil. In that regard's distillery industry is one of them. The work focus on the effect of distillery industry wastewater on the seed germination of *Triticum aestivum*, *Arachis hypogaea* and *Vigna radiate* crops. The investigation was carried out with different concentration of effluent for seed germination, root length, shoot length, fresh weight and dry weight of crops.**

**Keywords:** Biological; contaminates; concentration; effluent; growths; pollutants

## INTRODUCTION

Environmental pollution caused by the release of a wide range of compounds as a consequence of industrialization has assumed serious proportions (Jain et al., 2005). All the industries consume huge quantity of water and throw back almost an equal quantity of effluent which contains highly toxic materials in dissolved or suspended form (Kolhe et al., 2008). Water pollution disturbs the natural balance of ecosystem inside, resulting in the death of various aquatic species. Moreover, it also reduces the potential of water as a resource for the various uses (Pandey and Gopal, 2003). This is because pollution causes the water to become unsuitable for various uses and also difficult and more expensive to treat to accept quality for use. Aquatic organisms, including fish, accumulate pollutants directly from contaminated water and indirectly via food chain (Sasaki et al., 1997). Various kinds of pollutants build up in food chain and are responsible for adverse effects and death in the aquatic organisms. Fish are widely used to evaluate the health of aquatic ecosystem and physiological changes serve as biomarkers of environmental pollution (Camargo and Martinez, 2007). Moreover, certain insects and plankton species are recognized as bio-indicator species of aquatic pollution.

Distillery industries are high income paid as well as high pollution loaded industry. The ethanol produced from molasses which comes out from sugarcane industry waste (Baskar et al., 2003). In distillery industry processing, cleaning the floor, cooling water and spend wash around 60 to 100 liters of waste water generated to produce 1 liters of alcohol. The raw spent wash generated after fermentation and distillation is acidic in nature having dark brown colour with unpleasant odour, high COD and BOD (1,00,000 and 45,000 mg/l) as well as high dissolved and suspended solid. Spentwash as a distillery waste is posing disposal problem. Regular application of distillery effluent may affect soil physical and chemical properties viz., infiltration rate, hydraulic conductivity, water retention capacity, electrical conductivity, pH, availability of nutrients and also results in adverse effects on microbial biomass and population which might alter the fertility status of the soil. The various metallic and nonmetallic elements act as nutrients but at the higher concentration they show toxic effects on seed germination and seedling growth, ultimately adversely affecting plant growth and yield. Om et al. (1994), while studying the combined effect of different concentrations of wastes of distillery and sugar mill, observed inhibition of seed germination, seedling growth and biomass in okra (Abelmoschus esculentus L.). In the distillery effluent, various metals/nonmetals individually may not be toxic to the plant but in combination they may be toxic. On the other hand Zalawadia et al. (1996) studied the inhibitory effect of distillery effluent in combination with fertilizer on plants as well as on soil properties. Experiments conducted by Dutta and Boissya (1999) for studying the effect of low concentration of paper mill effluent on growth and field

**Table 1:** Average physicochemical parameter of distillery industry waste water

| S.No | Parameters | Parameter |
|---|---|---|
| 1 | Color | Brown |
| 2 | Odure | alcoholic |
| 3 | pH | 3.5 |
| 4 | DO | 1.5 |
| 5 | BOD | 5970mg/l |
| 6 | COD | 3682 mg/l |
| 7 | Oil and Grease | 12mg/l |
| 8 | Temperature | $80^oC$ |
| 9 | Electrical Conductivity | $2.23Scm^{-1}$ |
| 10 | Total dissolved Solid | 1480 mg/l |
| 11 | Suspended Solid | 790 |
| 12 | Dissolved Solid | 1650 |
| 13 | Chloride | 250 |
| 14 | Calcium | 261 mg/l |
| 15 | Magnesium | 68 mg/l |
| 16 | Sulphate | 419 mg/l |
| 17 | Iron | 2.8 mg/l |
| 18 | Lead | 0.065 mg/l |
| 19 | Zinc | 0.26 mg/l |
| 20 | Copper | 0.135 mg/l |
| 21 | Potassium | 113 mg/l |
| 22 | Phosphate | 4.9mg/l |

*Except Color, pH, Conductivity and temperature all value is in mg/l

NPK contents in rice showed increase in growth and yield of crop. The time has come to look back to time tested effect of polluted water on the crops. One thing is certain that crops grown with wastewater are healthy and beneficial since they recharge the soil. Billions of microorganisms are activated in healthy soil for the benefit of the farming community. Some time waste water acts as a good soil conditioner and improves the physical, chemical and biological properties of the soil. The regular and untreated discharges distillery industry effects the crops growth and also effect the fertility and productivity of soil.

The main goal of this work is to study the effect of distillery effluent on germination of Wheat (Triticum aestivum), peanut (Arachis hypogaea) and green gram (Vigna radiate). The growth rates of seed are measure with their root length, fresh and dry weights are also studied.

## MATERIAL AND METHOD

### Material

The synethic waste water was make in Labotary and preserved at $20^oC$ until used. The initial physicochemical parameters of distillery industry waste water were mention in Table 1. .The seed of Wheat (Triticum aestivum), peanut (Arachis hypogaea) and green gram (Vigna radiate) were sterilized using 0.1% of mercuric chloride solution to remove the microbes after thorough wash.

### Method

For biochemical tests, using six soil pots whose dimension are 10cm height x 10cm length x 10cm width respectively. Red soil was collected without any contamination by distillery factory effluent and sieved (2mm mesh). About 2kg of soil was taken in separate pots. Six different concentrations (viz., 0%, 20%, 40%, 60%, 80% and 100%) of effluent were prepared and poured into each pot. Control was also maintained and irrigated with tap water.

### Analytical method

Physico-chemical parameters of distillery industry wastewater , temperature ($^oC$), colour (visibility), pH (log scale), electrical conductivity (EC), dissolved oxygen

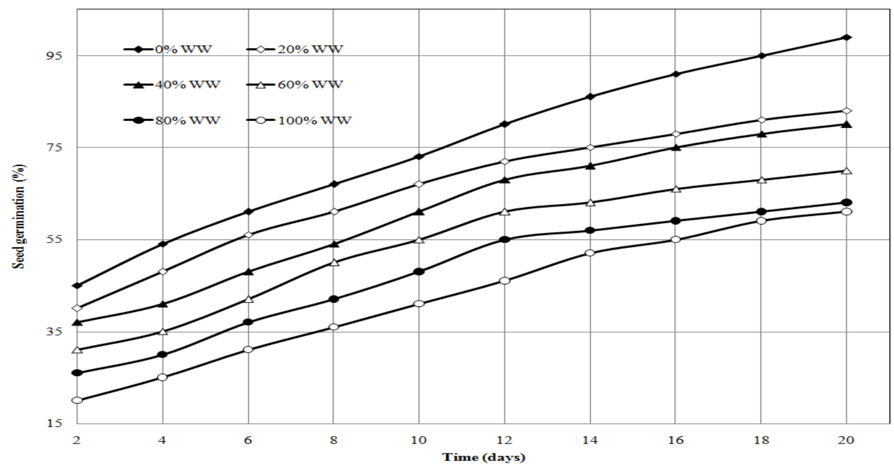


**Figure 1.** Effect of distillery waste water on wheat crop germination

**Table 2.** Effect of distillery industry waste water on root length, fresh weight and dry weight of wheat

| S.No | E (%) | Root length | Fresh Wt(mg) | Dry Wt(mg) |
|---|---|---|---|---|
| 1 | 0% | 2.1 ± 1.1 | 39 ± 3.08 | 12 ± 1.08 |
| 2 | 20% | 1.7 ± 0.75 | 37 ± 2.12 | 12 ± 1.37 |
| 3 | 40% | 1.8 ± 0.28 | 35 ± 1.86 | 12 ± 2.04 |
| 4 | 60% | 1.7 ± 1.51 | 33 ± 1.21 | 10 ± 0.62 |
| 5 | 80% | 1.1 ± 0.82 | 32 ± 0.97 | 9 ± 0.87 |
| 6 | 100% | 1.5 ± 0.56 | 31 ± 2.41 | 9 ± 1.03 |

(DO), biological oxygen demand (BOD), total solids (TS), total suspended solids (TSS), total dissolved solids (TDS), chloride, alkalinity, total hardness, calcium, magnesium, sulphate, phosphate and total iron were measured using the standard methods (APHA 1998).
Calculation and analysis of seed germination speed are as follows: Peak value and germination value were determined by the formulae,
*Peak Value* = Cumulative percentage germination on each day/No. of days elapsed since initial imbibitions (1)
*Germination value* = Peak value × Germination percentage (2)

## RESULT AND DISCUSSION

**Effect on wheat crops:** To determine the effect of effluent on wheat crops was carried out with different percentage of sample for 20 days. The result represent in Figure1. The results shows seed germination increase with increasing in days, with control effluent (0%) the seed germination was 99% in 20days of experiment. The seed germination decrease with increases in effluent percentage. When effluent was 20%, 40%, 60%, 80% and 100% the seed germination was 83%, 80%, 70%, 63% and 61%. The results attribute to high osmotic pressure in distillery industry effluent, which is not suitable for wheat crops. Ajmal and Khan (1983) proved, the lower concentration of effluent (25%) supports 100% seed germination and osmotic pressure associated with higher concentration of distillery factory effluent affect the germination in kidney bean, Phaseolus aureus and millet, Pennisetum typhoides. Rodger et al. (1957) reported that high osmotic pressures of the germination solution makes imbibitions more difficult and retard germination, while the ability of seeds to germinate under high osmotic pressure differs with variety as well as species. The reduction in germination percentage at higher concentrations and also be due to the excess amount of minerals and nutrients present in the effluent. Reduction in seed germination percentage at higher concentration of effluent may be due to the higher amount of solids present in the effluent, which causes changes in the osmotic relationship of the seed and water the reduction in the amount of water absorption take place with results in to reduction of seed germination due to enhanced effluent salinity (Deshmukh et al., 2004).

The effluent of distillery industry also affects the root shoot length and weight of the crops. There was a direct relationship between shoot length and concentration of effluent. Kaushik et al. (2004) clearly reported the toxicity of distillery factory effluent on the growth, photo synthetic pigments and nutrient uptake in wheat seedlings in aqueous versus soil medium. The root length of wheat, the fresh weight (mg) and dry weight (mg) are mention in Table 2. It was found that when the effluent was control the root length was 2.1 ± 1.1 in 20days, which decrease

**Table 3.** Effect of distillery industry waste water on shoot length of wheat

| S.No | E(%) /Days | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0.5 ± 0.11 | 2.3 ± 0.12 | 4.5 ± 0.18 | 5.5 ± 0.13 | 7.2 ± 0.19 | 8.5 ± 0.12 | 10.5 ± 0.17 | 11.8 ± 0.21 | 12 ± 0.29 | 12.1 ± 0.11 |
| 2 | 20 | 0.5 ± 0.19 | 2.2 ± 0.22 | 6 ± 0.18 | 6.5 ± 0.12 | 7.5 ± 0.11 | 9 ± 0.15 | 10.3 ± 0.17 | 10.5 ± 0.21 | 10.8 ± 0.28 | 10.9 ± 0.29 |
| 3 | 40 | 0.5 ± 0.12 | 3 ± 0.12 | 6 ± 0.11 | 7.1 ± 0.13 | 7.8 ± 0.13 | 9.5 ± 0.13 | 10 ± 0.18 | 10.3 ± 0.2 | 10.4 ± 0.27 | 10.6 ± 0.18 |
| 4 | 60 | 0.3 ± 0.11 | 2.8 ± 0.13 | 5 ± 0.18 | 6.6 ± 0.13 | 8 ± 0.12 | 8.3 ± 0.12 | 8.9 ± 0.19 | 10.1 ± 0.21 | 10.3 ± 0.2 | 10.4 ± 0.21 |
| 5 | 80 | 0.3 ± 0.07 | 2.5 ± 0.13 | 3.8 ± 0.28 | 5.4 ± 0.12 | 7.1 ± 0.12 | 7.3 ± 0.12 | 7.9 ± 0.16 | 8.1 ± 0.19 | 8.3 ± 0.29 | 8.3 ± 0.21 |
| 6 | 100 | 0.3 ± 0.11 | 2.1 ± 0.11 | 3 ± 0.18 | 5 ± 0.13 | 7.2 ± 0.12 | 7.8 ± 0.12 | 8 ± 0.16 | 8.1 ± 0.19 | 8.2 ± 0.27 | 8.3 ± 0.28 |

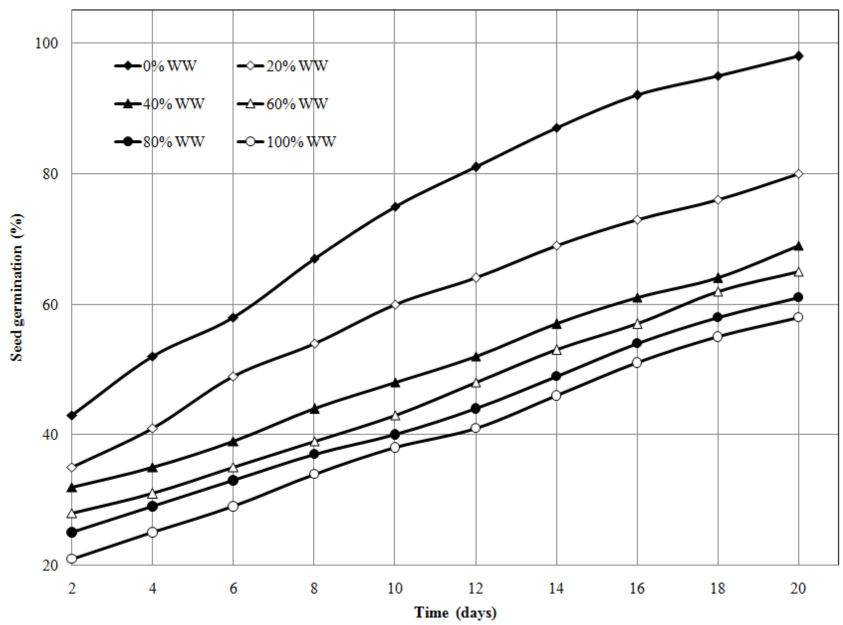


**Figure 2.** Effect of distillery waste water on peanut crop germination

1.5 ± 0.56 when effluent was 100%. Similarly fresh weight and dry weight also decreases.

The effluent also affects the shoot length of wheat, when effluent was in control with 2 days the shoot length was 0.5 ± 0.11 cm and increases upto 12.1 ± 0.11 cm on 20days. The shoot length was decrease with increase in effluent concentration, which is mention in Table 3.

**Effect on peanut crops:** To determine the effect of effluent on wheat crops was carried out with different percentage of sample for 20 days. The result represent in Figure 2. The result indicate that when the effluent percentage is zero the peanut growth is maximum 98%. When the percentage of effluent increase from 20%, 40%, 60%, 80% and 100% the seed germination were 80%, 69%, 65%, 61% and 58%. For the peanut crops normal pH and electrical conductive water is suitable. In this study, distillery industry effluent discharged soil had relatively higher clay and silt contents than the control soil. Other studies have found the same, like long term application of sewage effluents (Abdelnainm et al., 1987) and cotton ginning mill effluents (Narasimha et al.,1999). However, increased water holding capacity and electrical conductivity in the test soil may be due to accumulation of organic wastes and salts in the distillery industry effluents. Likewise, similar results were observed in soils discharged with effluents from cotton ginning mills

**Table 4.** Effect of distillery industry waste water on root length, fresh weight and dry weight of peanut

| S.No | Effluent (%) | Root Length (cm) | Fresh Wt. (mg) | Dry Wt. (mg) |
|---|---|---|---|---|
| 1 | 0 | 3 ± 1.28 | 13 ± 4.2 | 23 ± 1.64 |
| 2 | 20 | 3 ± 1.16 | 12 ± 1.2 | 21 ± 0.98 |
| 3 | 40 | 2 ± 1.64 | 12 ± 2.11 | 20 ± 0.18 |
| 4 | 60 | 2 ± 1.05 | 11 ± 2.08 | 18 ± 2.06 |
| 5 | 80 | 2 ± 0.02 | 6 ± 2.28 | 17 ± 1.92 |
| 6 | 100 | 2 ± 0.23 | 3 ± 3.29 | 12 ± 1.79 |

**Table 5.** Effect of distillery industry waste water on shoot length of peanut

| S.No | E(%) /Days | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0.2 ± 0.11 | 2 ± 0.12 | 7.5 ± 0.12 | 14 ± 0.12 | 21 ± 1.2 | 23.8 ± 0.12 | 26.1 ± 0.99 | 30 ± 0.49 | 31 ± 0.47 | 31.8 ± 0.51 |
| 2 | 20 | 0.2 ± 0.12 | 1 ± 0.13 | 3 ± 0.15 | 5 ± 0.14 | 8 ± 0.79 | 11.5 ± 0.62 | 15.5 ± 0.69 | 18 ± 1.09 | 18.6 ± 0.87 | 19.1 ± 0.59 |
| 3 | 40 | 0.2 ± 0.11 | 0.5 ± 0.12 | 5.5 ± 0.13 | 7 ± 0.29 | 8.5 ± 1.2 | 10.5 ± 0.52 | 11.9 ± 0.85 | 15 ± 0.91 | 15.9 ± 0.57 | 16.2 ± 0.69 |
| 4 | 60 | 0.2 ± 0.11 | 0.5 ± 0.12 | 3.5 ± 0.17 | 4 ± 0.71 | 5.5 ± 0.2 | 7.5 ± 0.12 | 8 ± 1.01 | 10 ± 0.99 | 11.6 ± 0.49 | 11.9 ± 0.29 |
| 5 | 80 | 0.2 ± 0.11 | 0.5 ± 0.12 | 2.3 ± 0.15 | 3 ± 0.19 | 5.5 ± 0.21 | 6 ± 0.24 | 7.7 ± 0.29 | 8 ± 0.89 | 9.7 ± 0.77 | 10 ± 0.49 |
| 6 | 100 | 0.1 ± 0.11 | 0.3 ± 0.12 | 1 ± 0.12 | 2 ± 0.14 | 3.7 ± 0.19 | 4 ± 0.52 | 5.2 ± 0.22 | 6 ± 0.29 | 7 ± 0.27 | 8.5 ± 0.21 |

(Narasimha et al., 1999), paper mills (Medhi et al., 2005) and sewage irrigated soils (Renukaprasanna et al., 2002). High electrical conductivity was also observed in soils treated with distillery effluents (Devarajan et al., 2002) and sodium based black liquor from fiber pulping for paper making (Xiao et al., 2005). In contrast, soils polluted with cement dust from cement industries had low water holding capacity and high electrical conductivity (Kumar and De Brito, 1995). The slight drop in the pH of the test soil is explained in terms of release of effluents with acidic in nature, containing agro based chemicals from distillery industry. Same was noticed in the discharges of distillery cane residues from distillery industry (Zende, 1996), application of sewage effluents (Bhogal et al., 2002) to soils decreased the pH.

Due acidic nature of effluent it affects the root length of peanut crops. The root length fresh weight and dry weight reduction decrease with increase in effluent concentration which is mention in Table 4.

The shoot length was also decrease with increase in the effluent concentration. When effluent was on control the shoot length of peanut was 31.8 ± 0.51 cm on 20days. With increase in concentration the shoot length fall continuously for the experimental duration, that is mention on Table 5.

**Effect on greengam crops:** To determine the effect of effluent on wheat crops was carried out with different percentage of sample for 20 days. The result represent in Figure 3. The results show that at 0% of effluent concentration green gram shows 99% of seed germination. When the effluent concentration were increase from 20%, 40%, 60%, 80% and 100% the seed germination decrease 80%, 75%, 70%, 67%, and 56% respectively. For the greengam high organic matter contain are not suitable which affect the growth of greengam. The higher organic matter of the test soil may be due to the discharge of effluents in an organic nature. Similarly, disposal of municipal organic compost (Chuasavathi and Trelo-ges, 2001), long term municipal waste (Anikwe and Nwobodo, 2002), and the effluents from cotton ginning mills (Narasimha et al., 1999) into soils, significantly increased the soil organic matter and total nitrogen content. Higher microbial population in the test soil possibly due to the presence of high organic matter in acidic effluents. Similarly, Monanmani et al. (1990) and Narasimha et al. (1999) reported that microbial populations were profusely increased in soils polluted with alcohol and cotton ginning mills effluents respectively.

The microbes also effect the growth of seed due same time both seed as well as microbes need food for their growth and development. With increase in the effluent concentration root length and dry and fresh weight was found to be decrease. The effect of distillery industry

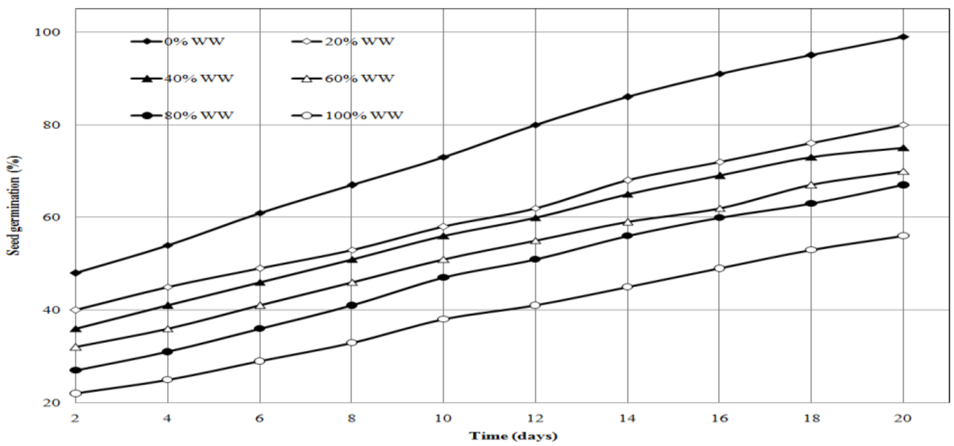


**Figure 3.** Effect of distillery waste water on greengram crop germination

**Table 6.** Effect of distillery industry waste water on root length, fresh weight and dry weight of greengram

| S.No | Effluent (%) | Root Length (cm) | Fresh Wt. (mg) | Dry Wt. (mg) |
|---|---|---|---|---|
| 1 | 0 | 5 ± 1.28 | 13 ± 4.2 | 23 ± 1.64 |
| 2 | 20 | 5 ± 0.16 | 12 ± 1.2 | 21 ± 0.98 |
| 3 | 40 | 4 ± 1.64 | 12 ± 1.11 | 20 ± 0.18 |
| 4 | 60 | 4 ± 1.05 | 11 ± 1.08 | 18 ± 0.06 |
| 5 | 80 | 2 ± 1.02 | 6 ± 0.28 | 17 ± 1.92 |
| 6 | 100 | 2 ± 1.23 | 3 ± 0.29 | 12 ± 1.79 |

**Table 7. Effect of distillery industry waste water on shoot length of greengram**

| S.No | E(%) /Days | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0.5 ± 0.11 | 2.3 ± 0.12 | 4.5 ± 0.18 | 5.5 ± 0.13 | 7.2 ± 0.19 | 8.5 ± 0.12 | 10.5 ± 0.17 | 11.8 ± 0.21 | 12 ± 0.29 | 12.1 ± 0.11 |
| 2 | 20 | 0.5 ± 0.19 | 2.2 ± 0.22 | 6 ± 0.18 | 6.5 ± 0.12 | 7.5 ± 0.11 | 9 ± 0.15 | 10.3 ± 0.17 | 10.5 ± 0.21 | 10.8 ± 0.28 | 10.9 ± 0.29 |
| 3 | 40 | 0.5 ± 0.12 | 3 ± 0.12 | 6 ± 0.11 | 7.1 ± 0.13 | 7.8 ± 0.13 | 9.5 ± 0.13 | 10 ± 0.18 | 10.3 ± 0.2 | 10.4 ± 0.27 | 10.6 ± 0.18 |
| 4 | 60 | 0.3 ± 0.11 | 2.8 ± 0.13 | 5 ± 0.18 | 6.6 ± 0.13 | 8 ± 0.12 | 8.3 ± 0.12 | 8.9 ± 0.19 | 10.1 ± 0.21 | 10.3 ± 0.2 | 10.4 ± 0.21 |
| 5 | 80 | 0.3 ± 0.07 | 2.5 ± 0.13 | 3.8 ± 0.28 | 5.4 ± 0.12 | 7.1 ± 0.12 | 7.3 ± 0.12 | 7.9 ± 0.16 | 8.1 ± 0.19 | 8.3 ± 0.29 | 8.3 ± 0.21 |
| 6 | 100 | 0.3 ± 0.11 | 2.1 ± 0.11 | 3 ± 0.18 | 5 ± 0.13 | 7.2 ± 0.12 | 7.8 ± 0.12 | 8 ± 0.16 | 8.1 ± 0.19 | 8.2 ± 0.27 | 8.3 ± 0.28 |

waste water on root length, fresh and dry weight is mention in Table 6.

Effect of distillery waste water was also effect the greengram shoot length. With the increasing of effluent concentration the shoot length was decrease continuously, which is mention in Table 7.

## CONCLUSION

It is concluding that distillery waste water is harmful for the crops growth. With treated effluent reduces 50% of seed germination due high organic and inorganic pollutant contains. From the experiment it was found that control effluent gives 99% of seed germination where 100% directly discharge gives 65% wheat, 58% peanut and 56% greengram seed germination. The root length was decreases for wheat 1.5cm, peanut 2cm and greengram 2cm and shoot length 8.3cm for wheat, 8.5cm peanut and 8.3 for greengram crops at 100% effluent. The high physicochemical parameter of effluent reduced the fertility and productivity of soil. It also decreases the biochemical parameter of crops. So government has been made norm for discharge limit of effluent and sticky banned for untreated waste water.

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