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Study of Initial Growth of Plants in Treated Water

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***Abstract*- India is one of the few countries in the world which is endowed with abundant land and water resources. Due to its geographical situation and tropical conditions, India experiences vast spatial and temporary variation in the rainfall. About one third of the country's area is drought prone, which includes parts of Rajasthan. Scarcity of water for irrigation in southern Rajasthan is a big challenge for the scientific community as well as policy makers. In the present scenario the irrigation water for crops comes from water bodies which has water from waste water treatment plants and many a times untreated water having solid waste including pathogenic bacteria and other microorganisms. Recycled irrigation water if not treated properly for pathogens may result into serious problems for the growing plants in the nurseries or crops in the fields. It can induce many types of diseases and other problems causing permanent damage to the young plants. This water therefore should be disinfected before using it for irrigation purposes. Chlorine in some form is generally used as disinfectant for making water pathogen free.**
In this paper the effect of added chlorine on the growth of plants is studied. Potted plants were watered with chlorinated water having different concentrations and their growth pattern was studied. The effect was studied for different plant parameters.

***Keywords:* microorganisms, plants, irrigation, chlorinated water, disinfection.**

I. INTRODUCTION

Water is very essential for life. Often this water is not fit for consumption by plants and humans as it contains many types of impurities, which may be floating, suspended or dissolved. These impurities are generally not very harmful to the living world as they are naturally occurring. These are treated in different steps before use. Out of these, the presence of microorganisms or pathogens are dangerous .Microbiological contamination of the water always has been a matter of big concern for entire living system existing on earth. Many types of bacteria, viruses and /or protozoa are responsible for different types of diseases occurring in plants and humans both. This water before consumption by humans or for irrigation is to be treated for disinfection.

II. WASTE WATER TREATMENT PROCESS

Toilet flushing, cleaning and washing in kitchen and bathrooms generate a huge volume of domestic waste water which can very conveniently be used for irrigation purposes in crop fields after treatment. Various stages of water treatment are as follows:

Stage I: Preliminary treatment of removing the floating impurities by screening. Floating objects like paper, nappies, diapers, ear buds, polythene bags, tissue paper, rags, etc. can be removed by using big screens or bars.

Stage II: Primary Treatment in sedimentation tanks, the speed of water from screens is controlled and slowed down. This results in settling down of heavy particles under the effect of gravity. Greases and oils come on top and float there, which can be easily skimmed off. The efficiency of this process is increased by using centrifugal force to make sand and similar particles to settle down.

Stage III: Here the organic matter still in dissolved state is allowed to be fed upon by microorganisms, which decomposes it into simpler substances. These simple substances act as food for a number of microbes which ultimately increases the density of pathogens in treated waters.

Stage IV: Disinfection of the water coming from stage III by using different chemicals.

III. DISINFECTION OF WATER

Disinfection means killing germs and pathogens in water. Water can be disinfected in many ways. These different techniques include ozonolysis, U V irradiation, sand-bed filter or using chemicals as disinfectants. Very less research has been conducted on treated water used for agricultural purposes. Many studies have been done regarding water microbial quality (e.g., pathogen prevalence, indicator organisms) with the objective related to reclaimed water, drinking and recreational water supplies but none included the effect of treated water on the agricultural fields, especially on the growth of crop plants.

Water can be made pathogen free by the use of chlorination method, which is a cheap, economical and remains the primary method of treating municipal water. This is a chemical method of disinfecting treated water by using either chlorine directly or indirectly to oxidize the pathogen enzymes which ultimately results in the death of pathogens. This technology of using chlorine as a disinfectant is adopted by few growers to disinfect their irrigation waters, but still its use to control pathogens through irrigation waters in crops is not completely studied and assessed.

The given research is focused on the disinfection of irrigation water through most economic and the cost effective method- "Chlorination". In this method the bacterial growth in the treated water is prevented by adding a disinfectant in the form of calcium hypo chloriite. Bleaching powder and/or Sodium hypochlorite may be used as disinfectant. Both are effective against bacteria, viruses and fungi. Sodium hypochlorite (NaOCl) solution is normally used for surface purification, bleaching and odor removal. This chlorinated water can also be used to irrigate lawn and garden. Under normal conditions, chlorinated water will not threaten microorganism populations. It has been found in research that chlorine in low doses i.e, 1-2mg/l is sufficient to kill the commonly occurring microorganisms including pathogens in waste waters. It is a matter of concern that the common disinfectant chlorine is a good oxidizing agent, and if watered along with treated waters, can be harmful to the plants in their initial stages of growth. In this paper the effect of chlorine and its concentration on initial growth of plants is studied. The effect of different chlorine doses applied during shoot and root emergence is studied.

The main aim of this research is to develop awareness about the use of treated waters for irrigating plants especially the crop plants or vegetables or the garden plants in their initial stage of growth, to minimize the soil contamination and thus providing conditions for safe and healthy growth of plants. This indirectly increases the yield of crop plants which ultimately proves that waste waters can be more beneficial for crops than plain normal water.

IV. METHODOLOGY

Groundnut and black gram seeds were taken and sown in pots filled with garden soil maintaining same conditions of temperature and humidity. These seeds were chemically sterilized. Different range of Cl- concentrations, i.e. 50ppm, 100ppm, 150ppm & 200ppm were prepared with calcium hypochlorite $CaOCl_2$ (Merck). The experiment was conducted in quadruplet i.e., 4samples for each observation.

There were two irrigation treatments:

(1)Non Chlorinated Water (Control)
(2)Chlorinated Water (Treated).

Pots of all treated plants were laid out in a completely randomized block design with four replicates. Plants under study were irrigated with respective treated waters daily at the same time with same amount of water for 2-3 weeks. Seedlings were watered everyday with treated chlorinated water for 21 days and then were harvested for collecting data like shoot length, root length, fresh weight and dry weight for comparison between different concentrations of chlorine dose given to them. The differences were considered significant at $p < 0.05$ when treatment's mean compared with control.

The observed data showed that, the growth patterns of growing plants with different concentrations of chlorine were different. It was observed that seedling grew very fast with treated waters as compared to control conditions for most of the parameters like

Fig: Chlorination Tanks used for disinfecting water

Shoot length, fresh weight and dry weight, but the growth rate decreased with increasing concentrations of chlorine. Root length was significantly improved with increasing chloride dose column are significantly different with respective control at p<0.05(LSD).

TABLE 1: Effect of chlorinated water used for irrigation purpose on black gram plant initial growth

TREATMENT DOSE	ROOT LENGTH (cm)		SHOOT LENGTH (cm)		PLANT FRESH WEIGHT (gm.)		PLANT DRY WEIGHT (gm.)	
Control 0 ppm Cl-	3.91	(0)	14.01	(0)	3.45	(0)	0.4 (0)	
50 ppm Cl-	4.65	(18.92)	14.75	(5.28)	3.99	(15.65)	0.62*(55)	
100 ppm Cl-	5.52	(41.16)	14.82	(5.78)	5.01*	(45.21)	0.74* (85)	
150 ppm Cl-	5.38	(37.59)	10.85	(-22.55)	2.78*	(-19.42)	0.41	(2.5)
200 ppm Cl-	4.40	(12.53)	7.92	(-43.46)	2.01*	(-41.73)	0.28	(-30)

Each value is the mean of 4 replicates. Values in parenthesis indicate % increase (+) or decrease (-) over control. Means bearing * in each column are significantly different with respective control at p<0.05(LSD).

TABLE 2: Effect of chlorinated water used for irrigation purpose on groundnut plant initial growth

TREATMENT	ROOT LENGTH (cm)	SHOOT LENGTH (cm)	PLANT FRESH WEIGHT(gm.)	PLANT DRY WEIGHT (gm.)
Control 0 ppm Cl-	2.82(0)	10.75(0)	2.98(0)	0.2(0)
50 ppm Cl-	3.56(26.24)	10.85(0.93)	3.05(2.34)	0.30(50)
100 ppm Cl-	4.53(60.63)	11.82(9.95)	4.13*(38.59)	0.39(95)
150 ppm Cl-	3.38(19.85)	8.85(-17.67)	1.98*(-33.55)	0.28(40)
200 ppm Cl-	2.40(-14.89)	5.94*(-44.74)	0.96*(-67.78)	0.19(-5)

Each value is the mean of 4 replicates. Values in parenthesis indicate % increase (+) or decrease (-) over control. Means bearing * in each

from 50 - 200ppm (0.5 –2.0mg L-1) in irrigation water.

This is due to the disinfection of harmful activities of various pathogenic microorganism i.e. Phytophthora infesting, Phytophthora cactorum, Fusarium oxysporum,, present in the surrounding vicinity of growing crop that may restricted the initial growth of growing plants, although root length was decreased due to high dose of Cl- i.e. 200 ppm and all other physical parameters were due to the inhibition of beneficial action of microbes for a surfeit growth of crop plants. In a report Hong has clearly stated that addition of 0.25 to 2 mg·L−1 calcium oxy chloride kills zoospores of numerous Phytophthora sp. Therefore it becomes clear that low free chlorine concentrations kills soil pathogens and enhances crop plant growth.

In conclusion, the irrigation water to fields or crop plants treated with chlorine was safe for the disinfection of soil microbial contamination.

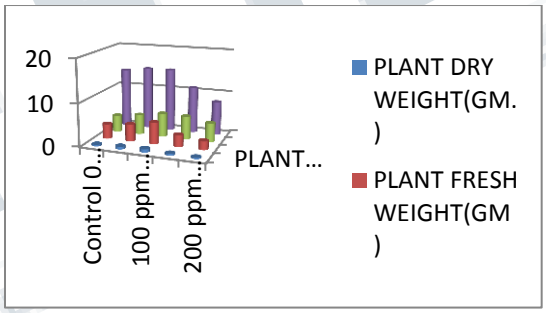

Fig: 1 Quantative analysis of different parameters for the black gram plant with treated water

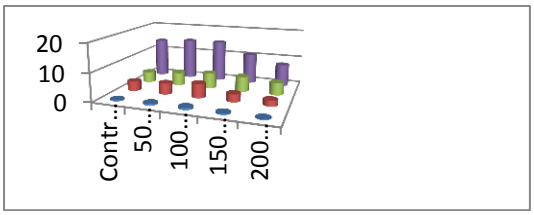

Fig:2 Quantative analysis of different parameters for the Groundnut plant with treated water

V. CONCLUSION

This study is very important because the results from the experiment can be used to help our society especially those who take care of our environment, especially plants. This study can help

them by making them aware if there is any danger in using chlorinated water or any other substance in watering plants. The results can also help farmers so that they will produce beneficial choice in the kind of water they will use to water the plants. By doing this the crop plant harvest will be in surplus amount and much healthier. This study can also help us in saving our environment and planet.

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