Effect of Various Types of Kitchen Waste Water on the Growth of Abelmoschus Esculentus, L.

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Abstract- *Domestic wastewater is generated continuously and in large quantities. It can serve as an alternative water nutrient source for irrigation. In the present study Abelmoschus esculentus L. (Lady's finger) was irrigated using different kitchen waste waters other than sink includes tap water as control, rice washed water, rice boiled water, tea filtrate mixed water, coffee filtrate mixed water and charcoal mixed water in pot experiment using two replicates. The effect was seen in soil nutrients and physical properties of the plant. Physico – chemical properties of the soil were measured before and after the experiment. The result showed that rice boiled water and charcoal mixed water could be a minor source of nutrients for the growth of lady's finger. There is no significant effect in the number of leaves during the course of experiment. Lady's finger was able to meet its nutrient requirements from wastewater and established good growth.*

Keywords- kitchen waste water, lady's finger, physico-chemical properties of soil, growth parameters

I. INTRODUCTION

Water is one of the most precious resources and a basic component of the growth of plants found on the earth, and is most often affected by anthropogenic activities and by industry. Pollution caused by human beings and industries is a serious concern throughout the world. Population growth, massive urbanization, rapid rate of industrialization and modern techniques in agriculture have accelerated water pollution and led to the gradual deterioration of its quality. Scarcity of freshwater is becoming an increasing problem in many areas of world primarily in the arid and semi-arid regions of the world (El Youssfi *et al*., 2012).

Globally, over 70% of freshwater consumption is devoted to agricultural activities. That is there is a large amounts of water are needed for irrigation in agriculture. If the wastewater can be used as an alternative water source for irrigation, the dual problems of negative environmental effects and huge water demand for agricultural irrigation would be solved. The reuse of wastewaters for purposes such as agricultural irrigation can reduce the amount of water that needs to be extracted from environmental water sources (Heidarpour *et al.*, 2007). The reuse of wastewater for irrigation purposes gives it a different fate as agricultural crops can make use of the extra water and nutrients.In agricultural practices, irrigation water quality is believed to affect the soil characteristics, crops production and management of water. Therefore, it is of concern to the people or farmers if an irrigant are used, which may contain constituents capable of creating adverse effects on the soil and on agricultural produce.

Along with the irrigation plans in the urban centers with conventional wastewater treatment systems, kitchen waste water other than sink reuse appears as the right solution for rural and peri-urban areas. Kitchen waste water refers to the waste water produced in kitchen such as the water produced by washing vegetables, rice washed water, charcoal water, coffee and tea dust ,rice boiled water, egg boiled water etc. The quality of waste water differs across different households. There can be both beneficial and damaging effects of waste water irrigation on crops including vegetables (Ramana *et al*., 2002, Saravanamoorthy and Ranjitha Kumari 2007). Therefore, it is necessary to study the impact of these waste water on crop system before they are recommended for irrigation.

Lady's finger (*Abelmoschus esculentus*, L.) is one of the most important edible and nutritious vegetable crops in India. It belongs to the family Malvaceae, originating from tropical and subtropical Africa. The nutritional constituents of lady's finger include carbohydrate, protein, phosphorus, calcium, magnesium, iron, vitamin A and C with traces of vitamin B. The present study aims to evaluate the impact of various types of kitchen waste water on the growth of ladies finger (*Abelmoschus esculentus*, L.) and to investigate the soil properties and growth parameters.

II. MATERIALS AND METHODS

Experimental site

A pot experiment was conducted at the green house of Department of Botany, Nirmala College for Women, Coimbatore using local garden soil. The maximum

temperature during the study period varied between 28 – 32˚C. Soil in this field is loamy and moderately rich in organic matter with a pH of 6.7.

Experimental design

Water samples were collected from the kitchen of Nirmala hostel, Nirmala College for Women, Coimbatore using sterilized sampling bottles. Soil samples were collected from the college garden and were sieved to remove pebbles and other soil particles. The soil was analyzed for various physico-chemical characters. Soil sampling and analysis were carried out before and after the experiment for each of the different water types used for irrigating the crops during the course of the experiment.

Certified Seeds of *Abelmoschus esculentus*, L. (lady's finger) were purchased from krishibhavan, Nilambur and were sterilized with mercuric chloride (0.1%) for 5 minutes and thoroughly washed with distilled water to avoid surface contamination and then soaked for 8 hr in distilled water and sown in pots containing potting soil. Before sowing these seeds ground water was applied to each pot in order to provide sufficient moisture for proper germination. Two replicates per treatment were established. Irrigation treatments included Control - Tap water, Sample A - Rice washed water, Sample B - Rice boiled water, Sample C - Tea filtrate mixed water, Sample D - Coffee filtrate mixed water and Sample E - Charcoal mixed water. Five seeds of lady's finger were planted in each pot and were irrigated sufficiently in the first few days to ensure germination and establishment. After crop establishment, equal amount of water samples were applied based on the requirement of plant using surface irrigation method. Proper care was taken to water the plants regularly. The crop was monitored and the growth parameters (shoot length, root length and leaf number) were measured and recorded under the different irrigation water type. Growth parameters were noted after 10 days of planting. Chemical parameters are measured using standard methods.

III. RESULTS AND DISCUSSION

Soil properties before experiment

When evaluating the data collected from this experiment it is clear that various water types do play a role in plant growth. The soil properties prior to planting are shown in Table 1. The initial value of soil pH of the experimental site was 6.7, which is slightly within the acidic range. The nitrate, nitrite, phosphate, ammonia, iron, fluoride and chloride contents in the experimental soil are at the range, which is essential for plant growth.

Table 1: Physical and chemical properties of the selected soil

Soil properties	Before the experiment	After the experiment					
		Sample (control)	Sample A	Sample B	Sample C	Sample D	Sample E
pH	6.7	6.7	6.7	6.7	5.8	6.0	8.2
Nitrate 0-150mg/L	45mg/L	40mg/L	55 mg/L	65 mg/L	50 mg/L	55 mg/L	75 mg/L
Nitrite 0.0-5.0mg/L	0.2mg/L	0.2mg/L	0.3 mg/L	0.2 mg/L	0.3 mg/L	0.5 mg/L	1.0 mg/L
Phosphate 0.0-5.0mg/L	0.5mg/L	0.4 mg/L	0.5 mg/L	1.0 mg/L	0.2 mg/L	0.5 mg/L	0.6 mg/L
Ammonia 0.0-5mg/L	0.5mg/L	0.5 mg/L	3.0 mg/L	0.5 mg/L	0.5 mg/L	1.0 mg/L	2.0 mg/L
Iron 0.0-10mg/L	2.0mg/L	2.0 mg/L	2.5 mg/L	4.0 mg/L	3.8 mg/L	3.5 mg/L	4.0 mg/L
Fluoride 0.0-5mg/L	1.5mg/L	2.0 mg/L	3.0 mg/L	2.0 mg/L	3.0 mg/L	2.0 mg/L	3.5 mg/L
Chloride 0.0-3mg/L	0.5mg/L	1.0 mg/L	0.5 mg/L	0.5 mg/L	0.4 mg/L	0.4 mg/L	0.7 mg/L

Effect of water type irrigation on lady's finger growth parameters

The results of plant height affected by different irrigation water treatment (Table 2) showed that there were slight variations in plant height. This variation in growth can be measured by subtracting the initial value from final value. Sample C (tea filtrate mixed water) irrigated plants are shorter than other water samples irrigated plants. Slightly higher value is noted in plants which are treated with sample B (rice boiled water). Also the plants were treated with sample E (charcoal mixed water) shows comparatively a good plant growth. It shows that the increase in shoot length is 1.18 cm in control from initial length to final length, in sample A the shoot length is 1.08 cm, in sample B the shoot length is 2.28 cm, in sample C the shoot length is 0.77 cm, in sample D the shoot length is 0.74 cm, and sample E the growth rate is 1.46 cm. It shows that, a slight variation occurs in plant growth within ten days of treatment. This result reveals that kitchen waste water can affect the growth rate of *Abelmoschus esculentus* in a good way.

Table-2 : Shoot length of the plants during experiment

Day	Sample (control)	Sample A (cm)	Sample B (cm)	Sample C (cm)	Sample D (cm)	Sample E (cm)
Day 1	14.8±0.42	15.22±0.38	14.67±2.29	15.35±0.21	15.35±0.91	14.4±2.68
Day 2	15.01±0.33	15.39±0.33	14.99±1.96	15.43±0.21	15.52±0.88	14.51±2.68
Day 3	15.13±0.3	15.6±0.42	15.4±1.41	15.5±0.28	15.65±0.77	15.0±2.39
Day 4	15.30±0.14	15.76±0.48	15.65±1.20	15.61±0.28	15.77±0.67	15.01±2.14
Day 5	15.55±0.07	15.92±0.60	15.82±1.09	15.7±0.31	15.81±0.67	15.2±1.96
Day 6	15.71±0.12	16.05±0.5	16.15±1.06	15.78±0.25	15.87±0.64	15.27±1.9
Day 7	15.81±0.17	16.16±0.5	16.35±1.06	15.86±0.33	15.95±0.65	15.44±1.68
Day 8	15.91±0.28	16.25±0.51	16.6±0.98	15.93±0.37	15.99±0.67	15.1±1.73
Day 9	15.95±0.31	16.31±0.56	16.8±0.98	16.04±0.41	16.04±0.68	15.72±1.95
Day 10	15.98±0.34	16.3±0.62	16.95±0.91	16.12±0.39	16.09±0.68	15.86±1.97
Change in length(cm)	1.18	1.08	2.28	0.77	0.74	1.46

(mean ±standard deviation)

Figure 2: Shoot length of tenth day of treatment

The average root lengths of *Abelmoschus esculentus* were recorded (Table 3) and there is a slight variation in root length in each experimental soil. Root length is minimum in sample B (rice boiled water) and maximum in sample C (tea filtrate mixed water). The increase in root length in sample C can be attributed to absence of nutrient in tea dust mixed water leading to the plants rooting deeper into soil for nutrient (Ekanayake *et al.*, 1985). Overall, the nutrient availability in other samples have positive influence on the plant height and number of leaves on *Abelmoschus esculentus*. Root length increased under nutrient stressed conditions. Increase in shoot length and decrease in root length of *Abelmoschus esculentus* under high nutrient application (40% sludge amended soil) has been reported by others (Singh and Agrawal, 2009).

For lady's finger the number of leaves was not significantly affected by the different water types used for irrigation in the first six days of growth, but there was a significant effect at the seventh day of growth. At sixth day the average number of leaves for the six water types was about four and there was a new emergence in the number of leaves from the seventh day of treatment. Plants treated with tap water (control), rice washed water (sample A), rice boiled water (sample B), coffee dust mixed water (sample D) and charcoal mixed water (sample E) had an average of about five leaves and plants which treated with tea filtrate mixed water (sample C) had about four. There is no change in the number of leaves which is treated with tea filtrate mixed water (sample C).

Table- 3 : Effect of different irrigation treatments on root length and leaf number of *Abelmoschus esculentus*

Samples	Root length(c.m)	Leaf number
Control	5.9±0.56	5.0±0.0
Sample B	5.57±0.03	5.0±0.0
Sample C	5.07±0.24	5.0±0.0
Sample D	6.55±0.21	4.0±0.0
Sample E	6.27±0.10	5.0±0.0
Sample F	5.06±0.28	5.0±0.0

(mean ±standard deviation)

Table 1 summarized the pH and chemical properties of cultivated soil after ten days of treatment. There was a significant difference in soil pH according to different watering waste water. Compared to initial soil, pH value decreased in Sample C (5.8) and sample D (6). pH value is constant in control (6.7) sample A (6.7) and sample B (6.7) and there is an increase in pH for sample E (8.2). Here, all other experimental soil samples are acidic and only sample E treated soil sample is alkaline in nature. This low pH is likely due to the decomposition of organic matter and production of organic acids in soils which is in line with the findings of Vaseghi *et al.*, (2005) and Khai *et al.*, (2008). Another explanation for this reduction in pH may be as a result of nitrification of NH4+ from the wastewater as observed by Stamatiadis *et al.*, (1999). However, other works (Rattan *et al.*, 2005; Rusan *et al.*, 2007) have shown that soil pH increased over a long period of irrigation with sewage and wastewater effluents. These investigations described the long term effect while this study was short term and considered kitchen wastewater. According to Mojiri (2011) an initial decrease in pH may be observed in soil irrigated with kitchen wastewater but after a while it may cause an increase of soil pH.

Comparing other chemical properties of the experimental soil with the initial soil components, the nitrate content is increased in five soil samples except control. No variations were noted in control. Nitrate content is high in sample E (75mg/l). High nitrate content in sample E is due to high rate of nitrate content in charcoal.

Nitrite content is also high in sample E (1.0mg/l) and less in control (0.2mg/l) and sample B (0.2mg/l). Presence of Phosphate content is high in sample B (1.0mg/l) and less in sample C (0.2mg/l). High amount of ammonia is present in sample A (3mg/l) and less in control (0.5 mg/l), sample B (0.5mg/l), sample C (0.5mg/l). Iron content is high in sample B (4.0 mg/l) and sample E (4.0mg/l) and less in control (2.0mg/l). Presence of fluoride is high in sample E (3.5 mg/l) and chloride is high in control (1.0mg/l).

In sample C there was a decrease in soil pH possibly because the pH of the tea dust mixed water was lower than that of initial pH of the soil. Under control and sample C there is a considerable decrease in N and P values in the soil after treatment. This is attributed to low availability of nutrients in the control and tea dust mixed water. However, the nutrient status of the soil improved with wastewater irrigation. Similar results have been reported by Burun *et al.*, (2006) who studied the effect of urban wastewater on growth and soil properties on irrigating *Hordeum vulgare*. It has been reported that application of wastewater irrigation resulted in about 4, 10 and 8 fold increases in N, P, K, respectively (Burns *et al.*, 1985).

Kiziloglu *et al.,* (2008) also reported an increase of organic matter, N, P, K, exchangeable Na, K, Ca, Mg, available phosphorus and microelements after irrigation with wastewater.

IV. CONCLUSION

This result show that appropriate utilization and water management practices will have to be allowing the reuse of different kitchen wastewater for irrigation and also reveals that rice boiled water is better for the growth of lady's finger than other kitchen waste waters. Growing plants in kitchen waste water is a possibility to recycle water which can solve problems of wastewater disposal as well as water scarcity. The current study reinforces to create awareness to the society towards the domestic waste water system to expand and deepen the awareness of the value of water. Government should take initiation in educating and engaging the public on wastewater treatment.

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