

Use of Treated Waste Water for Cultivation Through Hydroponics

A. S. Joshi

A. S. Joshi, Student, M.E. Civil
(Environmental engineering), SCOE,
Pune, aamods@gmail.com

V. S. Limaye

V. S. Limaye, Asso. Professor, SCOE,
Pune, vslimaye.scoe@sinhgad.edu

M. G. Saboji

M. G. Saboji, Asst. Professor, SCOE,
Pune, mgsaboji.scoe@sinhgad.edu

Abstract — Today, the world is suffering with food and water scarcity due to population explosion and unevenness in the climatic conditions. The world needs food which will satisfy its nutritional need and will be available at cheaper cost. One can grow the same in very small space. The world needs techniques which one can implement easily and without much of an investment.

Hydroponics is one of such technique. In hydroponics, plants are grown with the use of water and nutritional solution only. The nutritional solution contains the essential nutrients which are required for growth of the crops. The crops are artificially supported in the nutrient mixtures and made to grow using the nutrients provided only.

The water which we treat in our sewage treatment plants is mostly discharged into the drainages. But, as it was containing human excreta, it is rich in the N (nitrogen), P (phosphorous) and K (potassium). N, P, K are the macro-nutrients which are required for the growth of the plants. So, such water may be used by hydroponics system to grow the plants in the most economical manner.

This project tries to create opportunities for the people having arid land and small spaces to cultivate the crops for their daily need. The waste water generated can be used in this system to make it cost effective. This project tries to make the townships self-sustainable by creating an opportunity to grow the plants in small space by optimizing the resources. This may create a source of income to the townships and home owners

Keywords: explosion, climatic conditions, opportunities

I. INTRODUCTION

The world, especially under developed and developing countries, are facing population explosion. Most of the countries in this category are short of land and other natural resources. Due to

shortage of land and excessive populations, such nations are not capable of meeting the food supply demand of the people.

Hydroponics provides an option in such conditions. It is a technique through which one can grow the crops on all types of soils. The productivity is irrespective of the soil type. Hydroponics enables people to grow more than that of conventional farming.

The waste water which we treat in our sewage treatment plant is generally discharged into the drains as it is unfit for drinking. As the waste water was containing the human excreta (sewage), it is rich in N (Nitrogen), P (Phosphorous) and K (Potassium). N, P and K are the macro nutrients required for the plants, the treated waste water may be used in the hydroponics technique to grow the crops.

Hydroponics

Hydroponics is the technique in which crops are grown without soil. The main function of the soil is to support the plant and help it to grow vertically. Soil hold the water as per its moisture retention capacity. Roots of the plant absorb such water. All the nutrients that the plant uses for its growth and development are used from the water that is absorbed by the roots.

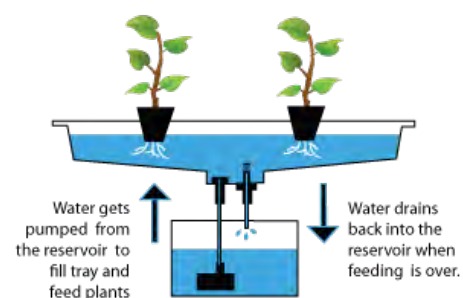


Fig. 1. Working of Hydroponics

In Hydroponics, soil substitutes are used to grow the plants. The substitutes are selected as per the crop type. The substitutes like gravels, perlite, coco peat, hydrotons etc are used. The required nutrients are provided through the water only. The nutrients are dissolved in the water and a nutritional solution is made. Such nutritional solution is provided to the plants. The solution can be recollected and reused. This saves a large amount of the water and makes cultivation possible in very small amount of water.

Benefits of Hydroponics

- Crops can be produced on non-arable land.
- Isolation from diseases or insect pests usually found in the soil
- High planting densities are possible which minimizes use of land area
- Efficient use of water and nutrients
- Ease of cleaning the systems.
- No weeding.
- Fruit of hydroponically grown plants can have more flavour

II. ABOUT PROJECT

Outline

The conventional farming consumes lots of water for producing crops. About One lakh litres of water is needed to irrigate 1 acre land for 1 inch depth (source: <https://edis.ifas.ufl.edu/ch153>). Whereas 1 lakh liters are not required for the crops. The demand of crops is much less than that of one lakh litres. There are numerous techniques to reduce the quantity of water. Use of advance irrigational techniques like Drip Irrigation, Spray Irrigation and Sub-Surface Irrigation are the techniques which reduces the water usage up to 40% (source: Southern Nevada Water Authority). Hydroponics is such advanced technique.

The awareness about hydroponics is very less in India. Hence, very few people use this technique for cultivation of the crops. However, now-a-days, this technique is being used for the fodder production in farms.

The project aims to produce same crop through two different techniques and with two different nutritional media and compare the outcome for its nutritional value and and commercial value.

Why Treated Waste Water?

The human excreta is a great source of Nitrogen, Phosphorous and Potassium. When it is flushed, it got mixed with water and hence the nutritions gets dissolved in the water also. We treat such sewage in our treatment plants for COD, BOD, TDS, Odour removal, Color Removal etc. However, in the treatment process, the N, P, K is not removed completely and so such specific treatment is provided to remove them. Hence, N, P, K content is present in the treated sewage water in considerable amount.

On commercial level, the nutritional mixture is prepared by dissolving the chemicals in the water. The chemicals are to be selected appropriately depending upon the crops. The solutions are made of various artificial chemicals hence they became costly for large area. But, as the product from the solutions have higher yeild, productivity and quality, the cost is considered to be bearable.

Experimental Setup



Fig. 2. Experimental Setup

For construction of the experimental setup, 5 trays have taken. The pots are kept in the tray as per the bifuraction. The traysand pots are of good quality plastic. The pots have arrangement for aeration at bottom.Total 13 pots are filled with various combinations of coco peat, perlite and soil. The details are shown in the table. Cocopeat is a crushed coconut coir. The coir is crushed and dried. Later it is compacted and packed in plastic. Cocopeat is selected as alternative to soil as coconut coir has a good moisture holding capacity.

Perlite is good aeration material. It provide good aeration and has a good water holding capacity too. The crop selected is Coriander. Each pot is sowed with 1 gm of Coriander seeds.

Table gives the details about the crate and the material filled in.

TABLE I.: Details of Experimental Setup

| | No. of Pots | Material | Feeding |
|--------|-------------|--|---------------------------------|
| TRAY 1 | 3 | Perlite | Treated Waste Water |
| | 3 | Coco peat | |
| TRAY 2 | 3 | Perlite | Artificial nutrient Solution |
| | 3 | Coco peat | |
| TRAY 3 | 3 | Soil | Tap water |
| TRAY 4 | 1 | Perlite with coco peat layer at bottom | Treated waste water |
| | 1 | Coco peat with perlite layer at bottom | |
| TRAY 5 | 1 | Perlite with coco peat layer at bottom | Artificial Nutritional solution |
| | 1 | Coco peat with perlite layer at bottom | |

Treated Waste Water Sample

This treated waste water sample is acquired from the “Father Agnell’s Vidyankur School” plant. Dr. Mapuskar have established a stabilization tank in the school to treat the sewage waste generated in the school. The inlet to this tank is the outlet of Malaprabha Digester (i.e. the digested remains of Black Water) and Grey water. The output obtained is a combination of the mixture of both the samples. The outlet sample has no odor.

TABLE II: Details of Analysis of Treated Waste Water

| Sr. No. | Parameters | Value | Method of Analysis |
|---------|---|--------|---|
| 1. | Chemical Oxygen Demand (mg O ₂ /lit) | 65 | Open end acid reflux method followed by titration |
| 2. | Biochemical Oxygen Demand (mg O ₂ /lit) (3days@27°C) | 20 | BOD incubator followed by Titration |
| 3. | Total Dissolved Solids (ppm) | 650 | Gravimetric Method |
| 4. | Total Nitrogen as N (ppm) | 40.32 | Kjeldahl Nitrogen Method |
| 5. | Total Phosphorous as P (ppm) | 10.32 | Spectrophotometric Method |
| 6. | Total Potassium as K (ppm) | 14.00 | Flame Emission Spectrophotometer |
| 7. | Total coli form (No. per 100) | 100 | MPN method |
| 8. | E-coli | Absent | Pour and Plate Method |

The project has been started. The plantation process is completed and the plants are allowed to grow and start the process of fruit formation. The plants are expected to give the fruits by the end of next two months. So, by the end of February, it is expected that the crops will grow healthy.

The primary readings of the sample are with us. It is expected that the nutrient contents from the sample are sufficient for the crops to produce and form the fruit.

Observations

The seeds in soil shows slowest germination rate.

The combination of Perlite with Coco peat layer at bottom shows fastest germination rate and growth rate.

The growth in both type of inputs (Treated water water and Nutritional Solution) shows equal pace of growing.

III. RESULTS

TABLE III: Results of Growth of Crop

| | Coco peat | Perlite | Soil | Perlite with Coco peat layer at bottom | Coco peat with Perlite layer at bottom |
|--|-----------|---------|------|--|--|
| Initial Seeds (gm) | 1 | 1 | 1 | 1 | 1 |
| Germination observed after (days) | 8 | 9 | 7 | 9 | 9 |
| Seeds germinated per pot (avg. no. of seeds) | 53 | 42 | 7 | 65 | 15 |
| Height of crop (avg. cm) | 7.5 | 7 | 9 | 8.5 | 6.5 |

IV. CONCLUSION

The pot with Perlite and Cocopeat layer at bottom proves more efficient in growing. It shows better density and better height of crops.

Use of treated waste water prove to be economical input as the productivity is same in both the cases of input i.e. treated waste water and artificial nutritional solution.

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