

A review : Experimental Investigation on Capillary Wick irrigation Technique

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Abstract - With increase in population, decrease in availability of agricultural land and water, need to identify and adopt water saving irrigation techniques and water management strategies. Capillary wick is an innovative technique of irrigation that uses minimum amount of water. This review paper includes literature reviews related to capillary wick irrigation technique and material used for capillary wick Irrigation Technique. Various research papers, articles and thesis have been referred to understand the Physics of Capillary action and Application of it on field and also study the effect, advantages, Limitation, material etc used for capillary wick irrigation technique. Comparison of Capillary wick Irrigation Technique with Other Traditional Irrigation Methods is also studied.

Keywords - Capillary, Wick Irrigation, water saving irrigation, Agriculture, Traditional Irrigation

I. INTRODUCTION

Agriculture continues to play a predominant role in the economy of Country. Looking the facts of the past and future trends of the world wide environmental situation, the unpredicted monsoon, water scarcity, frequent drought, depleting fertility of land, depleting ground water level, retreating quality of water and the financial condition of the small Indian farmers; the world resource Managers has to investigate various small scale and economical micro Irrigation techniques for our vulnerable small Indian farmers to enhance their live hood and to strengthen the backbone of the Indian economy. Across the world with increasing in population the available agriculture land is decreased. Due to this crop production is also reduced. So the need of urban agriculture arises. So this problem is mitigating by using urban farming. The availability of water required for urban farming is limited because water supply in city area is limited. For producing more crops per drop new techniques of irrigations with high water application efficiency has to be employed.

Conventional irrigation has a tendency to waste large quantity of water. The term “Capillary wick Irrigation system” describes a family of irrigation systems that apply water through the wick. These wicks deliver water onto the soil surface very near to the plate or directly to the root zone. The rate of water application is very low. Water requirement for this method is very less as compared to surface irrigation methods. Sub-irrigation systems save on labor, time and water costs compared to conventional watering systems when plants are grown in pots and are thus more economical and efficient than over head irrigation systems.

Plants need water to grow. Soil is on the list of things that water sticks to. Plants bury their roots deep into the soil that it can gather that is sticking to the soil. First, the water comes to the ground in the form of rain. It travels down through the soil, picking up nutrients from the soil. Eventually the water molecule runs into a tree root. The water molecule is attracted to the organic tissue that makes up the root of the tree. ^[1]

II. MATERIAL AND METHODS FOR CAPILLARY WICK IRRIGATION

2.1 Capillary wick Irrigation

Capillary wick irrigation system has been developed lately and attempted at several nurseries for mass pot plant production in Japan and South Korea. Wick systems were first used in India conjunction with clay pot irrigation.

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All sub irrigation system relay on capillary action to move water up through the growing media against gravity. Capillarity is result of attraction of water molecules of each other and other surface. The height to which water will climb above the water surface under capillary wick irrigation will depend on characteristics of the container and the growing media. The wetting process continues until the soil moisture status is in equilibrium. As long as there is water uptake by plants, water continues to flow up from the water reservoir to the growing media.

In capillary wick irrigation system the selection of an optimal wick material playing an important role in absorbing water from mat or reservoir. Although much kinds of material was not developed, but commonly used wick materials were compared of their absorbability. Different material has different capacity of water absorption.^[4]

2.2 Capillary Wick Beds

Capillary Wick Beds of growing plants where water wicks up from an underground water reservoir by capillary action. A wicking bed (WB) is a plant driven system where plants receive water from the reservoir. It is a way aimed coarse material-filled subsoil reservoir. WBs has been widely promoted as water-efficient water through capillary rise from a self-cont irrigation solution for small-scale and urban food gardens. In principle, in a WB, each plant should get precisely the right amount of water at a particular time, making the system a possible solution to the urban irrigation issues identified above. Indeed, WBs is gaining popularity among the gardening community because they are relatively simple and scalable. Water use can be reduced by up to 50% from conventional growing systems, as evaporation is significantly reduced.

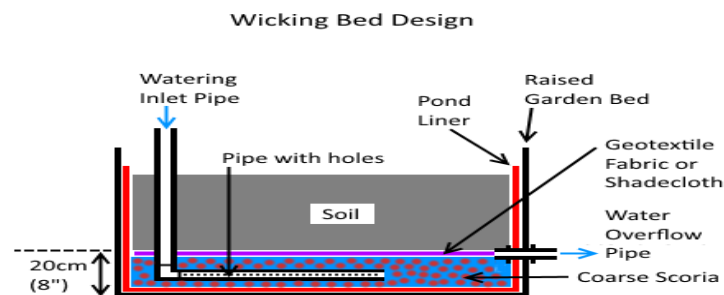


Fig 1. Capillary wick beds

2.3 Merits and Demerits of Capillary wick irrigation

➤ Merits of capillary wick irrigation were: -

- Different types of wicks were easily available in market used for the irrigation system.
- Eliminates the need if pressurized water system/ pumps that were costly.
- This low cost technology.
- Highly used for gardens and horticulture.
- Best method for arid region or where water is not easily available for irrigation.
- Easy to operate and maintain.
- Minimize soil erosion.
- Environmental friendly technology.

➤ Demerits of capillary wick irrigation were:-

- Difficult to use on large scale agriculture.
- Difficult for deep rooted plants.
- Selection of proper wick material is most important.

III. LITERATURE REVIEW

3.1 John M Wesonga, Cornelius Wainaina, Francis K. Ombwara, Peter W. Masinde, Patrick G. Home, “Wick material and Media for Capillary Wick Based Irrigation System in Kenya” (2014)

The authors had investigated the method of capillary wick irrigation in water deficit country Kenya as an effort to identify water saving irrigation and water management strategies. Experiments used five different wick materials namely, Blanket material(BM), Cotton woven(CW), Cotton Non-woven(CNW), 100% Polyester cloth material(CL) and Imported wick material(IWM) were tested for the irrigation system. Wick material was selected based on their water holding capacity (WHC), Water absorption pattern (WAP) and maximum capillary height. Results shows that of the five wick

materials tested, cloth material had the best performance in terms of WAP and maximum capillary height but had slightly lower WHC. (John M Wesonga, Cornelius Wainaina, Francis K. Ombwara, Peter W. Masinde, Patrick G. Home(2014)

3.2 Chi- Won Lee, In-Sup So, Sung- Woo Jeong, Moo- Ryong Huh, “Application of sub irrigation using capillary wick system to pot production” (2010)

The authors present the capillary wick system (CWS). CWS was used to reduce labour cost, waste water contamination of ground water, and use of fungicide compared to overhead irrigation. CWS helped to reduce remarkably the working hours for working hours for watering from 4 hours in OIS to just % minutes. Labour cost was saved 98% in CWS compared to OIS. Application of CWS for cyclamen pots. Results show that cyclamen pot irrigated by capillary wick had shorter petiole and more leaves than those by OIS. This system was highly beneficial to get uniform pot products with high quality.

3.3 Archana V Fultariya, Nilkanth J Bhatt , Shilpa N. Chavda, V.J.Chitriya(2015) “Wick Material for Capillary Wick based Irrigation System and observes wetting front advance using Polyester Wick

From the study author conclude that Polyester cloth material is most suitable local wick material for use in capillary wick based irrigation system. These finding pave way for further evaluation of the system with growing crops. Such evaluation should compare the capillary wick irrigation system to existing irrigation system such as drip irrigation. Crops suitable for growing using the system should also be determined. The moisture contact in soil using wick were difference at different distances and it also varies with number of wicks. Results show that the Capillary rice maximum in horizontal distance as compared to vertical distance.

IV. CONCLUSION

Capillary Wick Irrigation Method saves water as compared to farmer's regular method. Capillary wick irrigation technique gave high Water Use Efficiency as compared to conventional irrigation method. Capillary wick irrigation method is not useful for deep rooted plant. In some areas, it may be difficult to purchase or manufacture the pots and or water container. The use of Capillary wick irrigation is only applicable to small-scale agriculture.

REFERENCES

- [1] Chi- Won Lee, In-Sup So, Sung- Woo Jeong, Moo- Ryong Huh, “Application of sub irrigation using capillary wick System to pot production”, Journal of Agriculture & Life Science, volume 44(3) pp 7-14,2010.
- [2] Archana V Fultariya, Nilkanth J Bhatt , Shilpa N. Chavda, V.J.Chitriya “Wick Material for Capillary Wick based Irrigation System and observes wetting front advance using Polyester Wick, National conference on transportation and water recourses engineering, L.D.College Ahmadabad, 2015.
- [3] John M Wesonga, Cornelius Wainaina, Francis K. Ombwara, Peter W. Masinde, Patrick G. Home, “Wick material and Media for Capillary Wick Based Irrigation System in Kenya” ,2014.
- [4] Michael A. M., “Irrigation theory and Practice”, Second edition, Vikash Publishing House Pvt. Ltd.,pp-648,2006 .
- [5] Archana V. Fultariya “An experimental investigation on capillary wick irrigation Technique”, Thesis-Gujarat Technological University,May-2015
- [6] Bainbridge, David A, Ramirez Almoril, Jose Javier, “More efficient irrigation system for Desert and dry land restoration”, Alliant International University, San Diego, CA.
- [7] Niranjani P. K. Semananda *, James D. Ward and Baden R. Myers “Evaluating the Efficiency of Wicking Bed Irrigation Systems for Small-Scale Urban Agriculture”, Article- University of South Australia, Mawson Lakes Campus, Adelaide 5095, Australia, 2016.