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Exudation – An Advancement in Micro-Irrigation with Sub-Surface Drip Irrigation (Porous Pipe)

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Abstract

The awareness has slowly been developed for careful and effective utilization of natural resources like water and energy. Exudation, i.e., sub-surface irrigation with porous pipe can be an efficient water-saving method of irrigation for many less developed arid and semi-arid regions. Sub-surface drip irrigation, i.e., SDI has been an important part of agricultural irrigation throughout the world. During last three decades, sub-surface irrigation system is being used owing to its capability to apply water efficiency, low labor and low energy requirement and increase in quality and quantity of crop yield. The project work deals with introduction of new method of irrigation, the comparative study of conventional methods with exudation, i.e., SDI also studied. The project work also discusses use of sub-surface drip irrigation (SDI) for grapes and pomegranates. It also deals with benefits over drip irrigation, lacunas in conventional drip irrigation system. The main objective of this project work was to minimize evaporation losses in grapes and pomegranates, proper utilization of water, energy saving and minimization of labor cost and maintenance.

Keywords: *Exudation, sub-surface drip irrigation, SDI, arid and semi-arid regions, evaporation, crop yield*

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INTRODUCTION

There are many areas in the world which have been facing continuous scarcity of water. There is crucial need to develop new techniques to save water and irrigation of crops with minimum supply of water [1]. Lack of rainfall is the main constraint on agricultural production in arid and semi-arid areas of the world. Sub-surface drip irrigation (SDI) can be used to improve irrigation uniformity and water use efficiency in a number of different cropping systems by supplying low volume of water to the root zone of crops [2]. Irrigation with sub-surface porous pipe, i.e., exudation is one of the latest innovations for applying water and it represents definite advancement in sub-surface irrigation. SDI with porous pipe is defined by A.S.A.E. as application of water below soil surface with porous drip pipe which is buried under soil up to a certain depth. It can also be defined as "exuding drip irrigation system" with continuous seeping along whole length in which drippers are provided after one feet of length. SDI is low pressure, highly efficient irrigation system that uses buried drip tube to meet crop water needs. SDI technology has been a part of irrigated agriculture since 1960. SDI is flexible and can provide frequent and light irrigation [3]. Today, SDI is used throughout the world to irrigate field crops including inline and distant crops like vegetables and pomegranates and grapes [4].

EXPERIMENTAL WORK

Description

- SDI technology has been used on wide range for a number of different crops like sugarcane, tomato and corn.
- Still farmers are using conventional drip irrigation system to irrigate distant crops like pomegranates and grapes but drip irrigation has many lacunas regarding wastage of water and many more. Therefore, the authors adopted an advanced system of micro-irrigation, i.e., sub-surface drip irrigation in order to

minimize losses in drip as well as conventional irrigation system.

- After finding out many lacunas in drip irrigation system, the authors have adopted SDI system for grapes and pomegranates. They adopted this system over limited plants of grapes and pomegranates. First, they selected single rows for both plants.
- SDI pipe also called as DNPC, i.e., drip net pressure compensator is 16 mm in diameter and is made from polymer LLDPE and PVC. The drippers are provided after one feet length each.
- Pipe is laid below soil at a depth up to 20 to 30 cm along both sides of these plants.
- SDI is low pressure system and it requires only 1.2 to 1.5 kg/cm^2 pressure for operating.
- The distance of SDI laterals from these plants, i.e., 30 to 35 cm for grapes and 50 to 55 cm for pomegranates is recommended. These laterals are connected to the sub-main by takeoff, i.e., PVC connector.
- There are flushing pipes provided on both ends of laterals for the purpose of avoiding clogging and cleaning of laterals.
- Authors have carried out soil and water sample examination to predict whether given soil and water is suitable or not for the plantation of grapes and pomegranates.

INSTALLATION OF SDI SYSTEM

Preparation of Field

- Digging out the soil manually with the help of agricultural aids on both sides of grape and pomegranates row.
- Installation of SDI pipe can be unrolled and cut like a tape. The authors have used 100 ft. porous tube for installation in the field. Installation is a very easy process as porous pipe is very light in weight and it is done manually (Figures 1 and 5).

Fig. 1: *Installation of SDI.*

Fig. 2: *Underside View of Porous Drip Tube.*

Fig. 3: *Wetted Zone below Porous Drip Tube.*

- Once it gets buried the authors checked pressure inside laterals with a pressure meter. Working pressure should be in the range of 1.2 to 1.5 kg/cm^2.

Fig. 4: *Pressure and Drip Tube Connection Monitoring.*

- The holes on sub-main pipe are made by a 16 mm drilling tool. Then laterals are connected to the sub-main with 16 mm take off, i.e., PVC connector and rubber grommet.

Cleaning

- Increasing the pressure inside laterals more than 1.5 kg/cm^2 unplug the flushing ends. To ensure safe working of SDI system it has to be done once in a month.

MODEL FABRICATION

The authors have fabricated the model of SDI system in order to study whole system on a small scale. The model and its components demonstrate whole SDI system and give an idea about the project work.

Fig. 5: *Making of Flushing End.*

Fig. 5: *Model of SDI System.*

OBSERVATIONS

After studying and observing disadvantages of conventional drip irrigation system, it is decided to adopt SDI system for pomegranates and grapes. Once it got installed, the authors compared the SDI system with existing drip irrigation system including parameters like discharge, evaporation, percolation, infiltration and clogging. The drippers of SDI system having discharge are 2 L/h and spacing between two drippers is 1 ft. so that control, light and line irrigation could be achieved.

The laterals are buried under soil; therefore, no water oozes out on surface so that problem regarding evaporation gets eliminated. As no water comes out of the soil surface, there is no weed growth above the bed [5–10].

OBSERVATIONS

Variables	Traditional irrigation	Drip irrigation	SDI
Type of irrigation	Flooding	spot	line
Minimum unit pressure necessary	Large delivery by gravity	2.5 to 3 kg/cm^2	1.2 to 1.5 kg/cm^2
Discharge	Heavy discharge	Dripper capacity = 16L/h	Dripper capacity = 2L/h
Percentage saving of water	Excessive loss of water	Up to 40% water gets lost through evaporation	40 to 60% saving of water

RESULTS AND CONCLUSIONS

- From the above investigations, it is concluded that the SDI system with porous pipe possesses enormous advantages over conventional irrigation system.
- The authors recommend the use of SDI for grapes and pomegranates in order to minimize losses like evaporation, percolation, infiltration, dispersion of water, saving in electricity and low labor cost.
- The authors also recommend use of SDI for these crops in order to increase crop production, applying water and soluble fertilizers directly to the root zone which helps to improve productivity and health of crops.
- As SDI porous pipe is not exposed to heat radiations the life expectancy of this system ultimately increases up to 12 to 15 years.
- Besides the advantages of the system, SDI has some disadvantages like root intrusion. But this problem can be solved by avoiding water stress during growing season. Also roots are killed by acid injection at the end of season.

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