

# Uniformity Studies And Performance Of Sprinkler And Drip Irrigation

<sup>1</sup>T.Subramani , D.John Prabakaran<sup>2</sup>

<sup>1</sup>Professor & Dean, Department of Civil Engineering, VMKV Engg. College, Vinayaka Missions University, Salem, India

<sup>2</sup>PG Student of Irrigation Water Management and Resources Engineering , Department of Civil Engineering in VMKV Engineering College, Department of Civil Engineering, VMKV Engg. College, Vinayaka Missions University, Salem, India

## ABSTRACT

*Performance evaluation of irrigation has been an important area of research for better management of water resources. The uniformity coefficient, UC and distribution uniformity, DU, as a performance parameter were analyzed. The average UC and DU values for drip irrigated areas were 80.9% and 68.9%, respectively. These values for sprinkler irrigated lands were 86.8% and 79.9%, respectively. The overall result showed that both UC and DU values were lower in drip irrigation than sprinkler irrigation. Interpretation of the field data not only enables evaluation of the performance of the irrigation practice, but helps identifying the measures required to improve the system performance. The use of drip irrigation enhances irrigation efficiency relative to conventional techniques (such as gravity systems, which include flood irrigation of entire fields, and furrow irrigation using shallow channels or ditches to carry water to the crop). With proper management, application efficiencies for a well designed, installed, and maintained irrigation system can be in the range of 80 to 90 % for the area irrigated. Without proper water management, they are typically 55 to 65 %.* Drip irrigation can reduce exposure to water risks and input costs making an agribusiness operation more resilient, profitable and solvent.

**Keywords:** Uniformity Studies, Performance, Sprinkler, Drip Irrigation

## 1.INTRODUCTION

Water is essential substance for sustaining life on the earth. Its consumption by the agriculture sector continues to dominate the overall requirements of water. Moreover the increasing population, urbanization and unsustainable consumption of water have further imposed the greater demands on water in arid and semi regions of the country. Thus it becomes indispensable to properly manage water at all levels in order to fulfill their food and fiber requirements. Management of water resources at macro level is quite costly and time taking, even though unavoidable. On the contrary the management of water at field level is relatively inexpensive, more feasible, and easily workable and can be implemented in short span of time. In India, generally traditional flood irrigation methods (basin, border and furrow) are used to irrigate crops, where in the entire soil surface is almost flooded without considering the actual consumptive requirements of the crops. These practices have created the problems of water logging and salinity and reduction in the overall irrigation efficiency hardly up to 30 percent. Though both drip and sprinkler irrigation method of irrigation are treated as MI, there are distinct characteristics differences between the two in terms of flow rate, pressure requirement, wetted area and mobility. While drip method supplies water directly to the root zone of the crop through a network of pipes with the help of emitters, sprinkler irrigation method (SIM) sprinkles water similar to rainfall into the air through nozzles which subsequently break into small water drops and fall on the field surface. Unlike flood irrigation method, DIM supplies water directly to the root zone of the crop, instead of land, and therefore, the water losses occurring through evaporation and distribution are completely absent. The on-farm irrigation efficiency of properly designed and managed drip irrigation system is estimated to be about 90 percent, while the same is only about 35 to 40 percent for surface method of irrigation. In sprinkler irrigation method, water saving is relatively low (up to 70 percent) as compared to drip irrigation since SIM supplies water over the entire field of the crop. The system's almost continuous operation at low flow rates and operating pressures allow the grower to irrigate with lower-cost, smaller pumps through smaller, lightweight pipes which may deliver as little as 15 or 20 m<sup>3</sup>/m. The irrigation pumping requirement drops from the 7 to 4 m<sup>3</sup>/m per m<sup>2</sup> at 50 to 40 psi typical for sprinklers to 5 to 2 m<sup>3</sup>/m per m<sup>2</sup> at 20 to 6 psi for trickle irrigation systems. So 0.06 m<sup>3</sup>/m capacity water well solely dedicated to supplying 3 to 4 sprinklers may be used to trickle irrigate 2 to 4 acres of vegetables or small fruits, with enough extra capacity to meet normal household needs. Drip irrigation systems can apply frequent and small amounts of irrigation water at many points of a field surface/subsurface near the plants found the estimation of energy losses due to emitter's connection in trickle irrigation laterals was very important. The use of drip irrigation enhances irrigation efficiency relative to conventional techniques (such as gravity systems, which include flood irrigation of entire fields, and furrow irrigation using shallow channels or ditches to carry water to the crop). With proper management, application efficiencies for a well designed, installed, and maintained irrigation system can be in the range of 80 to 90 % for the area irrigated. Without proper water

management, they are typically 55 to 65 %.<sup>1</sup> Drip irrigation can reduce exposure to water risks and input costs making an agribusiness operation more resilient, profitable and solvent.

## **2.DRIP IRRIGATION**

Drip irrigation systems can be classified as traditional drip irrigation system, subsurface drip irrigation (SDI) and low cost alternative systems. A traditional drip irrigation system contains a main line and sub-main lines/header (to carry water to drip lines), laterals or drip lines (to distribute water to the outlets at base of plants), emitters (outlets to plants), a pump or pressure source, a control valve (to turn system on and off), a check valve (to prevent backflow into water source), a fertilizer injector (to apply fertilizer directly into irrigation water), a filter and a pressure regulator. More sophisticated system can include air vents, meters, timers, controllers and/or drains.. As expected, the water saving for vegetable crops varies from 12 percent to 84 percent per hectare over the conventional method of irrigation. Similarly, water saving varies from 45 percent to 81 percent per hectare in fruit crops. In crops like cotton, coconut and groundnut, water saving varies from 40 percent to 60 percent per hectare. Importantly, water saving in sugarcane, which is one of the water-intensive crops, is over 65 percent per hectare when compared to conventional method of irrigation.

### **2.1 Advantages Of Drip Irrigation**

- Drip systems are adaptable to oddly shaped fields or those with uneven topography or soil texture; these specific factors must be considered when designing the drip system.
- Drip systems also can work well where other irrigation systems are inefficient because parts of the field have excessive infiltration, water puddling, or runoff.
- Drip irrigation can be helpful if water is scarce or expensive. Because evaporation, runoff, and deep percolation are reduced, and irrigation uniformity is improved, it is not necessary to “overwater” parts of a field to adequately irrigate the more difficult parts.
- Precise application of nutrients is possible using drip irrigation. Fertilizer costs and nitrate losses can be reduced. Nutrient applications can be better timed to meet plants’ needs.
- Drip irrigation systems can be designed and managed so that the wheel traffic rows are dry enough to allow tractor operations at any time. Timely application of herbicides, insecticides, and fungicides is possible.
- Proven yield and quality responses to drip irrigation have been observed in onion, broccoli, cauliflower, lettuce, melon, tomato, and cotton.
- A drip irrigation system can be automated. For an example of automated drip irrigation, see the Malheur Experiment Station’s 1998 onion drip irrigation trial results.

It is clear from the above that the adoption of drip method of irrigation in crop cultivation not only increases water saving and productivity of crops but also reduces the cost of cultivation and weed problems. Importantly, DIM also helps to increase the germination of seed (cane) and the recovery rate of sugarcane. Though drip method of irrigation is proved to be an effective technology for increasing crop productivity, one can always question the credibility of the results of research station based studies as the conditions prevailing at farmers’ field are totally different from research station where trails are carried out. However, studies available based on filed level data also suggest that drip irrigation is economically suitable for different crops. A few studies carried out using farm level data in high value crops like banana, grapes and sugarcane also suggest that DIM increases water use efficiency, productivity and reduces cost of cultivation for different operations Significant amount of saving in electricity use due DIM has also been observed using field data. Importantly, these field based studies found that the investment in drip irrigation technologies is economically viable for farmers even at 15 percent discount rate, without availing subsidy from government.

## **3. SPRINKLER IRRIGATION**

Among the two micro-irrigation technologies, the research on sprinkler irrigation appears to have not much developed as compared to drip irrigation. In fact, unlike drip irrigation method, studies using field level data (published in standard journals for Indian context) are seldom available. Most of the studies are mainly used experimental data for its analysis, which of course may not completely reflect the farm level condition. The available results suggests that yield improvement and water saving in sprinkler irrigation is less striking, though the picture does vary considerably across crops and across space. This can be seen from the results of experimental data presented in INCID report pertaining to 15 crops carried out in different locations in India. The crops are grouped into three categories namely food grains, oilseeds and other crops for the purpose of comparison. Except for a few crops reported in, considerable amount of water saving and yield improvement has been noted in all other crops. Not surprisingly, water saving due to SIM is found to be relatively higher among food grain crops, whereas relatively higher yield gain is observed in oilseed crops. Sugarcane, a water-intensive crop, does not show any impressive result in terms of water saving and yield gain due to the adoption of SIM, implying that the sugarcane is shows not substantial gain due to the adoption of SIM. This system use sprinklers operating at pressures ranging from 70 to over 700 kPa to form and distribute "rain like" droplets over

the land surface. In most common systems; such as, hand-move, solid-set, side-roll, or big gun, a lateral line comes off of the main line to deliver water to the sprinkler nozzles. The position of the lateral may be permanent as in a solid set, or movable as in hand-move and side-roll systems. The spacing between the successive positions of the lateral along the mainline is called lateral spacing. The spray area that is wetted by each sprinkler nozzle at a particular operating pressure is designed as the wetted diameter. The wetted diameters are overlapped along the lateral to promote a more uniform distribution of water application. Sprinkler systems apply water efficiently, however, have relatively high capital costs and low labor requirements, and use more energy than other application methods. Sprinkle irrigation is adaptable to many soils and terrains. Sprinkler irrigation is a method of applying irrigation water which is similar to natural rainfall. Water is distributed through a system of pipes usually by pumping. It is then sprayed into the air through sprinklers so that it breaks up into small water drops which fall to the ground. The pump supply system, sprinklers and operating conditions must be designed to enable a uniform application of water.

### **3.1 Suitable Crops**

Sprinkler irrigation is suited for most row, field and tree crops and water can be sprayed over or under the crop canopy. However, large sprinklers are not recommended for irrigation of delicate crops such as lettuce because the large water drops produced by the sprinklers may damage the crop.

### **3.2 Suitable Slopes**

Sprinkler irrigation is adaptable to any farmable slope, whether uniform or undulating. The lateral pipes supplying water to the sprinklers should always be laid out along the land contour whenever possible. This will minimize the pressure changes at the sprinklers and provide a uniform irrigation.

### **3.3 Suitable Soils**

Sprinklers are best suited to sandy soils with high infiltration rates although they are adaptable to most soils. The average application rate from the sprinklers (in mm/hour) is always chosen to be less than the basic infiltration rate of the soil (see Annex 2) so that surface ponding and runoff can be avoided. Sprinklers are not suitable for soils which easily form a crust. If sprinkler irrigation is the only method available, then light fine sprays should be used. The larger sprinklers producing larger water droplets are to be avoided.

### **3.4 Crop Response To Sprinkler**

The trials conducted in different parts of the country revealed water saving due to sprinkler system varies from 16 to 70 % over the traditional method with yield increase from 3 to 57 % in different crops and agro climatic conditions.

### **3.5 General Classification Of Different Types Of Sprinkler Systems**

Sprinkler systems are classified into the following two major types on the basis of the arrangement for spraying irrigation water. A well-planned watering system can help you avoid over watering, which not only wastes water but can be harmful to your plants. Knowing how much water your plants need, and periodically monitoring and maintaining your irrigation system are the keys to saving both water and money.

#### **3.5.1 Soaker Hoses**

Most gardeners are familiar with soaker hoses, which sweat water along their entire length. Soaker hoses can be used to thoroughly water dense plantings or individual plants. You can also customize a watering system to your garden by attaching soaker hoses to solid hoses. This way, you avoid wasting water in areas that do not need it.

#### **3.5.2 Drip System**

Drip irrigation is the most water-efficient way to irrigate many different plantings. It is an ideal way to water in clay soils because the water is applied slowly, allowing the soil to absorb the water and avoid runoff. Drip devices use a fraction of the water that overhead spray devices use. "Point source" drip systems are comprised of drip tubing that is laid throughout a planting bed and feeds water directly to the base of the plants at a rate the soil can absorb without losing water to misting, overspray, or runoff. There are many different types of drip equipment, including drippers, bubblers, soakers (inline emitters), and micro-sprayers. Drip systems can be customized to meet each plant's needs. However, you should not mix different equipment in the same zone or distribution line, if possible.

In other words, you wouldn't put inline emitter pipe in the same zone with bubblers. Use separate zones for each type of equipment. The discharge rate of drip emitters varies from one-half gallon per hour to two gallons per hour and depends on the plant and its size, as well as the soil type. Micro-sprayers use much more water — up to 15 gallons per hour, but still much less than above-ground sprinklers. Generally, you will need at least one emitter device for every two-and-a-half feet of plant canopy.

#### **3.5.3 Traditional Automatic Spray System**

Among traditional automatic spray systems are pop-up spray heads that can be adjusted to spray a full circle, half circle or quarter circle. The disadvantage of spray heads is that they are often less efficient than rotor heads or drip systems, because they put water down on the ground faster than our clay soil can absorb it. Whatever heads you use, you want to make sure they are spaced so that each head sprays to the next head, or what is called "head-to-head" coverage. All heads should be of the same type and by the same manufacturer to get uniform distribution of water.

#### **3.5.4 Rotor System**

Rotor systems are generally more efficient than spray heads. They apply water at a much slower rate than spray heads, allowing the soil to absorb moisture more efficiently. In the past, rotors haven't been used for smaller turf areas, but

there are new rotors specifically designed to apply water at less than half-an-inch per hour, and with a radius of less than 15 feet. Application patterns and radius are adjustable, which can conform to odd-shaped areas.

### **3.5.5 Perforated Pipe System**

This method consists of drilled holes or nozzles along their length through which water is sprayed under pressure.

This system is usually designed for relatively low pressure (1 kg/cm<sup>2</sup>). The application rate ranges from 1.25 to 5 cm per hour for various pressure and spacing. Based on the portability, sprinkler systems are classified into the following types:

### **3.6 Advantages Of Sprinkler Irrigation**

- Expansive land leveling is not required.
- Water saving irrigation intensity can be changed in accordance with the infiltration capacity of soil.
- High efficiency due to uniform water distribution.
- No special skills trained personal can operate the system reasonably well.
- Ease and uniform application of fertilizers and pesticides through irrigation system.
- Possibility of applying minute quantity of water for germination and other irrigation systems.
- Frequent and light irrigation possible giving better response from the crops.
- Increase in yield and quality, early ripening, water conservation and alternative value of specific period saving of labor, machinery, fertilizer and pesticides.

## **4. MATERIAL AND METHODS**

### **4.1 Sprinkler Irrigation**

#### **4.1.1 Experimental Site**

An experiment was conducted on the experiment farm of agricultural college in Chennai.

#### **4.1.2 Experimental Setup**

For hydraulic studies of mini sprinkler irrigation system separate experimental setup was made in open field. Objective of such study was to optimize the design variables such as nozzle size, operating pressure, radius of influence, discharge of sprinkler for different conditions etc. Experimental setup consisted of pump(5 HP), main (PVC pipe of class II 90 mm diameter) and submain pipe(PVC pipe of class II 63 mm diameter), filters(sand filter of capacity 25 m<sup>3</sup>/hr and screen filter of 25 m<sup>3</sup>/hr), laterals, risers, sprinkler head, pressure gauge. Under this set up four makes of mini sprinkler were evaluated in this study. A twin nozzle 5022 U (yellow + green) and three single nozzle mini sprinklers 427 G AG (orange), 427 G,AG (green), and Super 10 (blue) respectively, used to study their performance on field.

#### **4.1.3 Measurement Of Discharge**

The experiment was conducted at five different operating pressures of 2.0, 2.5, 3.0, 3.5 and 4.0 kg/cm<sup>2</sup>. The required operating pressure at the nozzle was adjusted by the valve and bypass arrangement. To measure the discharge from the nozzle at sprinkler position, 1.27 cm inner diameter rubber tube was fixed at one end of 5022 U (twin nozzle) and its other end was put in the plastic bucket of 20 liter capacity. For remaining three single nozzle mini sprinkles, discharge was measured by dipping the nozzle into the bucket. Time taken to fill the bucket was 1 minute noted by stop watch for each combination and the observations were replicated thrice to get accuracy in results. The water collected in bucket was measured with the help of graduated cylinder and then converted in discharge per hour.

#### **4.1.4 Suitable Crops**

Sprinkler irrigation is suited for most row, field and tree crops and water can be sprayed over or under the crop canopy. However, large sprinklers are not recommended for irrigation of delicate crops such as lettuce because the large water drops produced by the sprinklers may damage the crop

#### **4.1.5 Suitable Slopes**

Sprinkler irrigation is adaptable to any farmable slope, whether uniform or undulating. The lateral pipes supplying water to the sprinklers should always be laid out along the land contour whenever possible. This will minimize the pressure changes at the sprinklers and provide a uniform irrigation.

#### **4.1.6 Suitable Soils**

Sprinklers are best suited to sandy soils with high infiltration rates although they are adaptable to most soils. The average application rate from the sprinklers (in mm/hour) is always chosen to be less than the basic infiltration rate of the soil (see Annex 2) so that surface ponding and runoff can be avoided. Sprinklers are not suitable for soils which easily form a crust. If sprinkler irrigation is the only method available, then light fine sprays should be used. The larger sprinklers producing larger water droplets are to be avoided.

#### **4.1.7 Suitable Irrigation Water**

A good clean supply of water, free of suspended sediments, is required to avoid problems of sprinkler nozzle blockage and spoiling the crop by coating it with sediment.

## 4.2 Sprinkler System Design

### 4.2.1 Determine System Design Capacity

When planning an efficient automatic irrigation system, you must first determine the correct Sprinkler System Design Capacity how much water is available for residential irrigation. If the system will be installed using city water, follow the steps below. If the water will be drawn from a lake or well, your Hunter dealer or the pump installer will have the specifications for pressure and volume.

### 4.2.2 Water Pressure (PSI)

To check the water pressure, attach a pressure gauge to the outside faucet closest to the water meter. Make sure that no other water is flowing at the residence. Turn on the faucet and record the number in the area provided to the right. This is the static water pressure in pounds per square inch or PSI

### 4.2.3 Water Volume (GPM)

To determine the volume of water available for the system, you need two pieces of information:

- Water meters will generally have the size stamped on the meter body. The most common sizes for residential meters are 5/8", 3/4", and 1". In some areas the water supply hooks directly into the city main without the use of the water meter. In these cases, simply enter the size of the service line in the space provided.
- Measure the outside circumference of the pipe that runs from the city main to the house. An easy way to do that is to wrap a piece of string around the pipe, measure the string, and use the table to the right to convert the string length to pipe size.

### 4.2.4 System Design Capacity

Using the System Design Capacity Chart on this page, locate the three numbers you just recorded to determine the Sprinkler System Design Capacity in gallons per minute (GPM). Record this number in the GPM box. Next, locate your system's static pressure and move down that column and find the system's working pressure; record it in the PSI box. Working pressure will be used when choosing sprinkler heads and designing the system. You have now established the maximum GPM and the approximate working pressure available for the sprinkler system. Exceeding these maximums may result in inefficient watering or a condition referred to as water hammer, which could cause serious damage to the system.

## 4.3 Irrigation Scheduling Methods: Sprinkler Irrigation

**Table 4.1** Irrigation efficiency for various sprinkler irrigation techniques

Irrigation technique	Efficiency (%)
Lateral hand move	65-80
Travelling gun	55-70
Centre-pivot	
Standard (400m)	75-80
With corner	65-85
Long	65-85
Linear Moving	65-85
Solid set	65-75

Sprinkler irrigation is often considered as being very effective compared to surface irrigation because it enables better control of water application. However, this control is dependent on a good quality level in the irrigation system design and in the selection of equipment, and also requires that the farmers develop appropriate skills for managing their irrigation system (knowledge and control of the pressures and flows that enable the system to distribute water uniformly over the field). Sprinkler irrigation systems are generally designed using standard single sprinkler performance data, available from laboratory tests, manufacturers or independent organizations. The tests are performed in fully controlled no-wind conditions according to the specifications described in the standards. Estimates of irrigation efficiency for sprinkler systems are presented in Table.4.1. The lower values reflect significant wind distortions or evaporation. The higher values indicates excellent management and favourable conditions. Actual on-field performance of sprinkler systems is often much lower than potential performance: on the one hand, because several disturbance factors that farmers cannot control (wind, variations of pressure on systems, etc.), were not taken into account in the initial design. Experimental and research data related to the on-field effects of such disturbances on the system can require complex processing, and approaches to use them for improving system design have been developed only very recently, on the other hand, because of farmers' lack of skill in managing the system itself (poor knowledge of system operating

pressure and flow, of the actual operating conditions, of the influence of the settings and the mode of operation of the equipment on the system performance).

#### **4.4 SOLID SET SPRINKLER SYSTEMS**

Precision of the average water application depth: only 41% of farmers know with an acceptable precision (< 10%) the average water application depth that they actually achieve on their field. This is essentially due to: ignorance of real sprinkler flow, a selection procedure for irrigation durations that gives more priority to convenience and labour organization than to the water application depth defined by scheduling methods, poor methods to estimate the on-field water application depth (0, 1 or 2 catch cans only, without taking into account the 'design' heterogeneity of the irrigation system). Uniformity of irrigation water application depth: The main causes that deteriorate water application heterogeneity are: irrigation system design methods do not take accurately into account the effects of wind, nor the variations in system supply pressure. So, the actual water application uniformity will be below the design uniformity, pressure deviation observed between external sprinklers on an irrigated plot is often too high. (Figure.4.1)



**Figure.4.1** Sprinkler irrigation

#### **4.5 Advanced Irrigation Method**

##### **4.5.1 Sprinkler Irrigation**

Water is applied as a spray or rain drops over the crop. In this method saving of water ranges from 25 to 50% for different crops. As the application rate is less than intake rate of soil, surface runoff does not occur. Soil moisture is maintained at optimum level.

##### **4.5.2 Low Energy Precision Application (LEPA) System**

LEPA system is a modification of sprinkler system in which water is applied directly to the furrow at very low pressure through drop tubes and orifice controlled emitters. Water is not sprayed with pressure as in sprinkler system. The system is used in conjunction with furrow designed to retain all applied water.

##### **4.5.3 Micro Irrigation Technique**

Micro irrigation is the latest and most efficient method of water utilization for crop growth. It has high water use efficiency. This advance method of irrigation has an efficiency up to 70 to 75%. Water is applied to the crop area near the root zone on a daily basis and as there is no water/moisture stress, the crop growth is not affected at all.

##### **4.5.4 Microjet Irrigation**

This gives throw distance of 1 to 4 m with a correspondingly larger wetted area of ground. The water discharge of the jets is 5 to 160 litres per hour.

##### **4.5.5 Microsprinkler Irrigation**

The discharge in microsprinklers currently available varies from 28 to 223 litres/hour, operating pressure 0.8 to 4.0 bar and throw distance 0.9 to 4 metres.

##### **4.5.6 Bubbler Irrigation**

Bubbler irrigation, a relatively new system, is designed to reduce energy requirements through inexpensive, thin walled, corrugated plastic pipe with a diameter that even the low pressure head from a surface ditch might suffice. The disadvantages in drip irrigation i.e. high energy consumption to pump water with pressure for distribution, clogging of drip emitters and damages to delicate screen filters, are all avoided.

#### **4.6 Financial Aspects**

##### **4.6.1 Unit Cost**

The unit cost of sprinkler irrigation system includes the cost of all components required for the system and depends upon location of the well, type of sprinkler, discharge, land holding, cropping pattern, topography and the total head. State level unit cost committees finalise average unit costs for sprinkler systems, which are also regularly revised. However, these may vary as per the actual site conditions and banks must finance the actual costs required for the sprinkler system.

#### **4.6.2 Time And Labour Required To Operate The System**

The adoption of sprinkler irrigation system reduces the amount of time and labour required by manifolds. Unlike the conventional method of irrigation, it does not require continuous supervision during irrigating the field.

#### **4.7 Economics**

Proper design of a sprinkler system does not in itself ensure success. The system should be operated in keeping with good irrigation practices. It should be ensured that the prime mover and the pump are in alignment. For these the drive shaft as well as the pump shaft should lie at nearly the same height to prevent too great an angle on the universal shaft. Service and installation procedures in respect of the pump and power units should be strictly observed. While laying the main and lateral pipes, always begin laying at the pump. This necessarily gives the correct connection of all quick coupling pipes. While joining couplings, it is ensured that both the couplings and the rubber seal rings are clean.

#### **4.7 Drip Irrigation**

##### **4.7.1 Experimental Site**

The study was conducted at Ariyanoor village in Salem, Tamilnadu. The site was in a low-lying area with nearby access to water for irrigation. The soil texture was sandy with a neutral pH (data from students not published), and the experiment was started in the middle of the dry season, when no rainfall was expected.

##### **4.7.2 Preparation Of Land And Garden Layout**

The total area of land used was divided into two equal areas to allow preparation of control (C) irrigated plots, which means pouring water directly on the soil surface surrounding a plant, and drip-irrigated (DI) plots that use our device for water delivery to the roots. Comparing results from C and DI plants allows the effectiveness of the device to be observed. Each plot was prepared in a similar manner as follows: In accordance with local procedures for garden preparation, soil was first softened with a small amount of water, and then dug to a depth of approximately 15cm for the entire area of each garden bed after first clearing the area of grasses and plants.

The soil was again dug the next day to obtain a uniform and workable soil consistency. Each maize plot was 396cm x 355cm with four rows of eight plants for a total of 32 C maize plants, and 32 DI maize plants. Spacing between rows of maize was 60cm, and between plants was 45cm. Each Chinese plot was 220cm x 340cm with four rows of 16 plants for a total of 64 C Chinese plants, and 64 DI Chinese plants. Spacing between rows of Chinese was 46cm, and between plants was 20cm. A diagram with measurements is available at request.

The basic components of any drip irrigation system are:

- Water source to provide the amount of water required at the necessary pressure to push water out of the drip emitters;
- Filter to remove particles from the irrigation water that may clog the drip emitters
- Control valve to open and shut off the water;
- Main lines in polyethylene to carry and distribute water to the laterals lines;
- Lateral lines in polyethylene to carry the water and distribute it to the drip emitters. The usual diameter of these lines range between 12 and 20 mm.

##### **4.7.3 Construction Of Drip Irrigation System**

The drip irrigation system was constructed entirely from materials found in the village of Ariyanoor, or with supplies found in Tamilnadu town (approximately 25km distance). As shown in, for each type of crop planted a tap in a 60L bucket was used to supply water to ½" PVC lines that ran the entire length of each row of crops. Each pipe supplied water to inverted 1.5L plastic water bottles, and then to smaller-gauge syringe tubing as in figure. At the tips, flattened and dulled syringe needles were used to control water flow, and covered to prevent blockage. These parts worked cooperatively to ensure efficient supply of water to the plants. First, the bucket is filled with water and the tap is opened. Water flows through the pipes to fill each bottle fixed under a hole. The syringe tubes and needles deliver water drop-by-drop, allowing water to stay at the root of each individual plant while preventing excess evaporation.

#### **4.8 Fertigation And Chemigation**

Fertigation (the injection of soluble fertilizer through the drip-irrigation system) should be considered an integral part of the fertility program based on soil testing. Detailed fertigation schedules for all major vegetable crops grown in Florida are available in the Vegetable Production Handbook for Florida. This series of EDIS publications is available online Proper nutrient management for vegetables grown with drip irrigation includes (1) soil testing, (2) understanding the recommendation, (3) correctly calculating fertilizer rates, (4) monitoring plant nutrient content, and (5) trapping residual nutrients by planting a second cash crop or a cover crop. In addition, fertilizer applicators should be properly calibrated. Conventional growers have a wide array of soluble-fertilizer sources to choose from. Important characteristics of liquid fertilizers are the fertilizer content (lbs of N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O/gallon of liquid fertilizer) and the ratio among elements. When all the P<sub>2</sub>O<sub>5</sub> is applied pre-plant, most vegetables require a 1:0:1 type of liquid fertilizer (as much K<sub>2</sub>O as N and no P<sub>2</sub>O<sub>5</sub>). However, certified organic growers have fewer choices for liquid fertilizers. The NOP rule limits the use of sodium nitrate (NaNO<sub>3</sub>) to 20% of the total N. For example, if the seasonal N rate is 150 lbs/A -- as for watermelon or cantaloupe (muskmelon), 20% of the seasonal N represents 30lbs N/A/season. If the seasonal N rate is 200 lbs/A -- as for tomato and bell pepper, 20% represents 40 lbs N/A/season. Some formulations of

seaweed or fish emulsions may be allowed by the NOP, but the use of these fertilizers in a drip-irrigation system may increase the risk of emitter clogging.

#### **4.9 General Features Of Low Cost Drip Irrigation**

- Water storage—usually a bucket or a drum,
- Water filtration
- Conveyance and water application lines with emitters (PE, 12 or 20 mm)
- Valves.

##### **4.9.1 Common Preparation Requirements**

- Prepare the area to be irrigated. This could be simple land preparation or involve the formation of planting beds .
- For best results, drip systems are used to irrigate level beds. If the drip tubes go uphill, downhill or around corners, the system will not give equal water flow from each dripping outlet.
- Construct the water container stand. Ensure that it can support the weight of the container and water when full.
- Mount the water container on the stand so that the water outlet is at the height necessary to provide the water pressure required to operate the system.
- Mount the container water outlet, water filtration and flow regulator fittings.
- Lay the water distribution system components that connect the water container to the individual drip lines. Make sure that the open ends are closed to avoid foreign material entering the pipe.
- Unroll the drip lines and lay them along the full length of each row of plants to be irrigated.
- Connect the drip lines with the water distribution system (header pipes).
- Flush the system to remove any foreign matter that may have entered the pipeline.
- Close the end of the drip lateral lines.

#### **4.10 Maintenance**

##### **4.10.1 Regular Maintenance**

The following activities should be performed as a regular part of the landscape

- maintenance program or at least once per month:
- Check plants and soil for signs of under watering or overwatering .
- Inspect the irrigation controller(s) to make sure it is working and that the
- watering schedule is properly set.
- Ensure all emission points are visible and above the finished grade.
- Emitters can quickly be buried with dirt and debris.
- Buried drip emitters clog easily.
- Buried drip emitters cannot be inspected.
- Requirement does not apply to irrigation systems specifically design for subsurface water application.

##### **4.10.2 Semi-Annual Maintenance**

The following maintenance activities should be performed at least twice per year:

- Replace batteries in controllers (electronic models).
- Controllers can lose the program or revert to default program if power is lost.
- Ensure all flush valve/cap locations are visible. Buried flush caps are difficult to find.
- Ensure valve boxes are visible and can be opened. Buried valve boxes are difficult to find.
- Inspect valves, filters, and pressure regulators for damage or leaks. Remove
- excess dirt and debris if present in valve box. Check wire splices.
- Move drip emitters/emission points away from the bases of the plants. In most cases, emission points should never be closer than one foot from the
- base of a mature plant. Most of the emission points should be located near
- the drip line (canopy edge) of the plant. Emitters located too close to the base of the plant are often difficult to inspect and repair.
- Most of a plant's water-absorbing roots are near the drip line.
- Watering too close to the base of the plant can cause root rot.
- Moving emitters away from the base of the plant promotes greater root structural support.

##### **4.10.3 Annual Maintenance**

The following maintenance activities should be performed at least once per year

- Clean valve boxes of dirt and debris.
- Flush filters. A hose can be attached to the flush cap to keep water out of the
- valve box.
- Debris can be drawn into the system if they are not flushed prior to opening the filter assembly. Flushing and cleaning may need to be performed more often depending on water characteristics.

- Inspect and clean filters. Damaged or torn filters should be replaced. Torn and damaged filters allow debris to enter the system.
- Flush laterals. Dirt and debris are drawn into the line are pushed towards the end of the lateral. Flushing and cleaning may need to be performed more often depending on water characteristics.

## **5.CONCLUSION**

Necessity of irrigation is generally because of the following situations.

- Rainfall is less than the water requirement of the plants.
- Rainfall is sufficient, but the spatial distribution of rainfall is not as per requirement.
- Rainfall is sufficient and the spatial distribution is also good, but the temporal distribution is not as per requirement.
- Advanced scientific development

Increase of food production. Modify soil or climate environment – leaching, Lessen risk of catastrophic damage caused by drought. Increase income & national cash flow, Increase labor employment, Increase standard of living. These irrigations helps to the following improvements in agriculture.

### **Water Application Efficiency**

One of the main advantages of SDI over other irrigation methods is that it has the Potential to be the most efficient irrigation method available today. The word potential is stressed because irrigation efficiency not only depends on the irrigation system itself, but also on its proper design, installation and management.

### **Potential Yield Increases**

It also can be used to frequently inject fertilizers and other chemicals such as acids, chlorine and even pesticides with the irrigation water. SDI systems often are managed to apply small amounts of water and other inputs daily or even several times a day. Small and frequent applications can be adjusted to match the water and nutrient needs of the crop.

### **System Underground**

Having the irrigation system underground and keeping the soil surface dry, in addition to reducing evaporation, allows farm equipment to enter the field even during irrigation events. All things considered, SDI is a highly efficient system which can help improve management of both irrigation water and crop nutrients. Because of economics, it has mainly been used to produce high value crops like vegetables and fruits, but its use in row crops is beginning to spread. SDI is very new to India and the region. Like any new product or system, it will require time to gain the knowledge and confidence in operating a new irrigation system.

## **REFERENCES**

- [1]. Amosson, S.H., L. New, L. Almas, F. Bretz, and T. Marek. 2002. Economics of irrigation systems. Publication B6113, Texas Cooperative Extension,
- [2]. The Texas A&M University System, 20 pages. Benham, B.L. and J.O. Payero. 2001. Filtration and maintenance: Considerations for subsurface drip
- [3]. irrigation (SDI). University of Nebraska Extension EC 01797, 6 pages.
- [4]. Burt, C. 2001. Evaluating drip. Irrigation Business and Technology. November/December, pp.35-39.
- [5]. Camp, C.R. 1998. Subsurface drip irrigation: a review. Transactions of the ASAE, 41(5): 1353-1367.
- [6]. CREA, 1993. Indicadores basicos de la región de Azuay. Cañar y Morona de Santiago, Cuenca, Ecuador.
- [7]. Deckers, J.A., O.C. Spaargaren, F.O. Nachtergaele, 1998. World Reference Base for Soil Resources (in press).
- [8]. Dercon, G., B. Bossuyt, B. De Bièvre, F. Cisneros, J. Deckers, 1998. Zonificación
- [9]. agroecologica del Austro-Ecuatoriano. PROMAS, Ediciones Universitario, Cuenca, Ecuador, 148pp.
- [10]. Farnworth, J., 1997. Agro Info: guidelines for world crop and livestock production. John Wiley & Sons, NY, USA, 576pp.
- [11]. Hart, W.E., H.G. Collins, G. Woodward, A.S. Humpherys, 1980. Design and operation of gravity or surface systems. In: Design and operation of farm irrigation systems (Jensen, M.E., ed.). ASAE Monograph, 3: 501-580.
- [12]. Jury, W.A., W.R. Gardner, W.H. Gardner, 1991. Soil physics. Fifth Edition. John Wiley and Sons, Inc., NY, USA.
- [13]. Subramani.T, Sivakumar.C.T, Kathirvel.C, Sekar.S, "Identification Of Ground Water Potential Zones In Tamil Nadu By Remote Sensing And GIS Technique" International Journal of Engineering Research and Applications, Vol. 4, Issue 12 (Version 3), pp.127-138, 2014.
- [14]. Subramani.T, Chandrasekaran.M, "Saline Ground Water and Irrigation Water on Root Zone Salinity", International Journal of Engineering Research and Applications, Vol. 4, Issue 6 (Version 2), pp.173-179, 2014.
- [15]. Subramani.T, Prasath.K, Velmurugan.P, Baskaran.V, "Impacts of Irrigation and Drought on Salem Ground Water", International Journal of Engineering Research and Applications, Vol. 4, Issue 6 (Version 3), pp.117-122, 2014.

**AUTHOR**



**Prof. Dr.T.Subramani** Working as a Professor and Dean of Civil Engineering in VMKV Engg. College, Vinayaka Missions University, Salem, Tamilnadu, India. Having more than 25 years of Teaching experience in Various Engineering Colleges. He is a Chartered Civil Engineer and Approved Valuer for many banks. Chairman and Member in Board of Studies of Civil Engineering branch. Question paper setter and Valuer for UG and PG Courses of Civil Engineering in number of Universities. Life Fellow in Institution of Engineers (India) and Institution of Valuers. Life member in number of Technical Societies and Educational bodies. Guided more than 400 students in UG projects and 150 students in PG projects. He is a reviewer for number of International Journals and published 102 International Journal Publications and presented more than 25 papers in International Conferences.



**D.John Prabakaran**, received his BE. Degree in the branch of agricultural Engineering in TamilNadu Agricultural University, Coimbatore. Now, he is working as a Programme Assistant (Agricultural Engineer) in ICAR-KVK, Myrada, Gobichettipalayam, Erode District. Currently he is doing his ME Degree in the branch of Irrigation Water Management and Resources Engineering in the division of Civil Engineering in VMKV Engineering College, Salem.