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Emission uniformity evaluation of installed drip irrigation system

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Abstract
The main function of drip *irrigation* is to meet consumptive water use requirements of a crop within certain hydraulic and uniformity conditions. The emission uniformity distribution in drip irrigation systems is important in irrigation water management and could serve as the basis for optimizing water use efficiency and crop productivity. The water distribution uniformity was then evaluated using the method – EU field test. The experiment was conducted at Hi-Tech Horticulture of RAU, Pusa, Bihar. General rating for uniformity are 90% or greater 80% to90%, 70 to 80% and for Less than 70% - Excellent, good, fair and Poor respectively. The absolute emission uniformity was found 95.14% in the drip irrigation system under polyhouse. Hence the drip irrigation system in water distribution uniformity is excellent.
Hence the drip irrigation system in water distribution uniformity is excellent. The emission uniformity distribution in drip irrigation systems is important in irrigation water management and it serve as the basis for optimizing water use efficiency and crop productivity.

Keywords: Drip irrigation, uniformity coefficient, polyhouse

Introduction

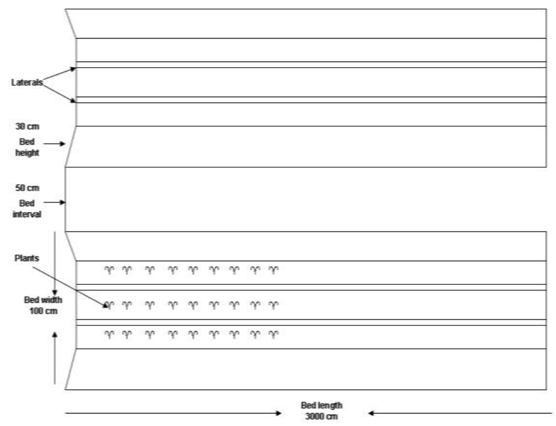
Drip irrigation has been used in horticultural operations since the middle of the 20th century (hillel) [3] and conventional drip irrigation is considered one of the most efficient irrigation systems. Drip irrigation has the potential to use scarce water resources most efficiently to produce vegetables (locascio) [4]. However, drip is an irrigation system whereby water is supplied under low pressure directly treating only to the plant roots (nautiyal *et al*.) [5]. material and methods. Drip irrigation is a method of controlled irrigation in which water is slowly delivered to the root system of multiple plants. In this method water is either dripped onto the soil surface above the roots, or directly to the root zone. It is often a method chosen over surface irrigation because it helps to reduce water evaporation drip irrigation is delivered to plant roots through a series of pipes, tubes, and valves. These parts, controlled by emitters and pumps, allow water to be focused in a particular area. In addition, drip systems can incorporate liquid fertilizer into the irrigation water. Drip irrigation systems can help reduce evaporation and runoff, and contribute to water conservation. However, before this system can work correctly it must be properly installed and managed. The two main types of drip irrigation are: Surface drip irrigation in which the water is delivered to the surface of the soil directly above the root system of the plants. This particular type of drip irrigation is mainly used on high-value crops. While in Subsurface drip irrigation, the water is applied directly to the root system. This type is used particularly in growing row crops. The main function of drip irrigation is to meet consumptive water use requirements of a crop within certain hydraulic and uniformity conditions. The emission uniformity distribution in drip irrigation systems is important in irrigation water management and could serve as the basis for optimizing water use efficiency and crop productivity. The water distribution uniformity was then evaluated using the method – EU field test. (mane & ayare, 2007)

Material and methods

The site is situated Hi-Tech Horticulture of RAU Pusa at 25° 85’ North latitude and 85° 40’ East longitude with an altitude of 678 m above the mean sea level

Cropping System

Cropping system is very important for good production. A better cropping system leads to better production. Raised bed planting system was used to plant the crop. Raised beds having bed width of 75 cm& depth 7cm had been made at an interval of 50cm. Carnation were planted at a row spacing of 30 cm and plant spacing of 30 cm.

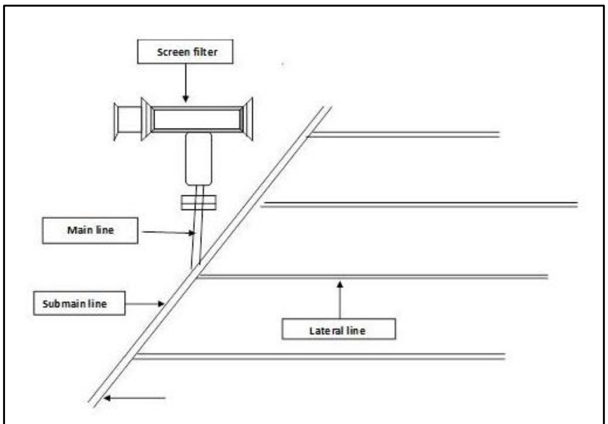


Bed layout

EU Field Test Method

Irrigation system

During the first three weeks after planting it needs overhead sprinklers to prevent young plants from drying out. Afterwards, it is possible to gradually change to drip irrigation (2 laterals bes per bed). The water needs to be filtered with a sand filter to prevent obstruction of the drip tubes. To ensure even distribution of water the drippers had been placed at a distance of 30cm.When a carnation crop is in full growth and healthy, it absorbs 6 to 7 liters of water per m^2 per day. Irrigation is very important for crop production. Without it plant cannot survive. Amount of irrigation requirement and time of its application is also important. Plant cannot survive below PWP. It is given when available soil moisture depleted to a certain value. Drip irrigation system is designed and installed for the irrigation requirement. A recommended daily irrigation is given to the crop. The plots were irrigated with drip irrigation system by providing two laterals per bed.



Emission uniformity

The EU during the field test is the ratio expressed as a percentage of the average emitter discharge from the lowest $1/4^{th}$ of emitter to the average discharge of all the emitters of the drip system. The average the lowest $1/4^{th}$ of emitter was selected as a practical value for minimum discharge, as recommended by the United States Soil Conservation Service for field evaluation of drip irrigation system and is expressed by the equation

$$EU_f = \frac{q_n}{q_a} \times 100$$

Where,

EU_f = the field test emission uniformity, percent

q_n = average of the lowest $1/^{4th}$ of the field data emitter discharge, l/h

q_a = average or design emitter discharge rate, l/h

q_a = average or design emitter

Table: Sample Form for Recording Emitter Discharge Rates in the Field for Calculating Field Emission Uniformity

Absolute emission uniformity

The field evaluation of uniformity is useful for improving the operation and management of existing system. The data for the field evaluation of EU should be taken from emitter discharge at a minimum of four locations along four different lateral line. The sixteen data collection locations should include the extremes and uniformly spaced locations throughout the representative blocks of laterals. The discharge of the emitter can be measured by selecting the first point, $1/3^{rd}$, $2/3^{rd}$ point and last emitter on the corresponding laterals in the block. Where there is more than one emitter per plant, the data should be taken for all emitters and average value from two adjacent emitters at each location should be considered. The absolute emission uniformity esteemed by equation as follows.

$$\mathbf{EU_a = 100} \quad * \quad \left[\frac{Q_{min}}{Q_{avg}} + \frac{Q_{avg}}{Q_x}\right] \times \frac{1}{2}$$

Where,

EU_a= absolute emission uniformity, percent

Q_x = average of the highest $1/8^{th}$ of emitter discharge, l/h

Q_{min}= minimum emitter discharge rate in the system, l/h

Q_{avg}= average or design emitter discharge rate, l/h

Procedure for Data Collection

Step-I

Choose four lateral lines and four emitters on each lateral per location.

Step-II

Measure the emitters discharge and calculate the emitter flow rate at two adjacent emitters (A and B, as per indicated in lay out) at each collection point by collecting the discharge for one minute in a graduated cylinder.

Step-III

Calculate the average emitter discharge for each of the sixteen locations.

Step –IV

Calculate the emission uniformity using equation 3.1.

General rating of EU_a values are

90% or greater	-	Excellent
80% to90%	-	Good
70 to 80%	-	Fair
Less than 70%	-	Poor

Location on lateral	Lateral location on the submain							
	Inlet end		1/3 down		2/3 down		Far end	
	ml	l/h	ml	l/h	ml	l/h	ml	l/h
Inlet end A								
B								
Avg.								
1/3 down A								
B								
Avg.								
2/3 down A								
B								
Avg.								
Far end A								
B								
Avg.								

Results

Emission uniformity of drip irrigation: As per equation the mentioned in the material & methods the emission uniformity determined by using values tabulated values below

Location on lateral	Lateral location on the submain							
	Inlet end		1/3 down		2/3 down		Far end	
	Ml	l/h	Ml	l/h	ml	l/h	Ml	l/h
Inlet end A	21.33	1.28	22.00	1.32	23.33	1.40	22.00	1.32
B	22.67	1.36	20.67	1.24	22.00	1.32	21.67	1.30
Avg.	22.00	1.32	21.33	1.28	22.67	1.36	21.84	1.31
1/3 down A	22.00	1.32	23.67	1.42	22.33	1.34	22.33	1.34
B	20.00	1.20	22.33	1.34	21.67	1.30	22.67	1.36
Avg.	21.00	1.26	23.00	1.38	22.00	1.32	22.50	1.35
2/3 down A	20.33	1.22	21.67	1.30	22.33	1.34	21.67	1.30
B	21.00	1.26	22.33	1.34	20.67	1.24	20.33	1.22
Avg.	20.67	1.24	22.00	1.32	21.50	1.29	21.00	1.26
Far end A	21.67	1.30	22.33	1.34	22.00	1.32	23.67	1.42
B	20.33	1.22	21.67	1.30	19.33	1.16	21.00	1.26
Avg.	21.00	1.26	22.00	1.32	20.67	1.24	22.33	1.34

Method – EU Field Test

Emission uniformity ($EU_{f)}$,

q_n = 1.255

q_a = 1.303125 then,

EU_f = 96.3%

Absolute emission uniformity (EU_a)

Q_{av} = 1.303125

Q_{min} = 1.24

Q_x = 1.37

Then, EU_a = 95.14%

The absolute emission uniformity was found 95.14% in the drip irrigation system under polyhouse. Hence the drip irrigation system in water distribution uniformity is excellent

Conclusion

The absolute emission uniformity was found 90% in the drip irrigation system under polyhouse in hi-tech horticulture RAU, Pusa. Hence the drip irrigation system in water distribution uniformity is excellent. The emission uniformity distribution in drip irrigation systems is important in irrigation water management and it serve as the basis for optimizing water use efficiency and crop productivity.

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