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Research Article

PERFORMANCE EVALUATION OF DIFFERENT TYPES OF WICKSUSED INWICK IRRIGATION SYSTEM

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Abstract: Though micro irrigation has many potential benefits, it has certain limitations such as high initial cost, problems related to clogging and salt accumulation, periodic maintenance including daily attention *etc.* With the objective of solving these limitations, a user-friendly irrigation method namely "wick irrigation" was developed by Centre for Water Resources Development and Management (CWRDM) for vegetable cultivation in homesteads, especially for terrace cultivation. This method of irrigation is cheap and efficient. The scientific principle behind this irrigation method is the uptake of water by the wick through capillary action. During past many years glass wool is being used as the wick material in wick irrigation. The availability of glass wool for making the wick is very difficult and also it is reported to have some allergic problems to the operator. In this context, a field study was conducted to evaluate the performance evaluation of different types of wicks *viz.* glass wool, cotton and silk wool for the wick irrigation system. The performance was compared on the basis of water uptake rate, soil moisture content, biometric observations of the crop *etc.* From the study, it was concluded that wick made up of glass wool has better performance in terms of biometric and yield parameters, water uptake rate and soil moisture content. It was also observed that the wick made up of cotton is on par with the glass wool wick. Considering the easiness of availability, eco-friendly nature and cost effectiveness, cotton wick can be used as a viable alternative for glass wool in wick irrigation.

Keywords: *Wick irrigation, Micro irrigation, Glass wool, Silk wool*

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Introduction

Irrigation plays an important role in various developmental projects in the country. The existing method of surface irrigation method is less efficient and confronted with many problems with regard to soil and water. Expansion of irrigation system is also essential for increasing food production. Micro irrigation is an effective tool for efficient irrigation, thereby conserving water resources. Though micro irrigation has so many potential benefits, it has certain limitations such as high initial cost, problems related to clogging and salt accumulation etc. With the objective of solving these problems, a user-friendly irrigation method "Wick Irrigation" was developed for vegetable cultivation in grow bags especially for terrace cultivation by Centre for Water Resources Development and Management (CWRDM). This method is cheap and at the same time water efficient. The scientific principle behind this method of irrigation is capillary action. A field study was conducted to evaluate the performance evaluation of different wick materials in wick irrigation system. The performance was compared on the basis of water uptake rate, moisture content, biometric observations of the crop etc.

Material and Methods

The experiment was conducted at KCAET, Tavanur situated at 10°53"33" N latitude and 75°59`14``E longitudes. The area receives rainfall mainly from the South-West monsoon and to certain extends from the North- East monsoon. Tomato variety "Anagha" was selected for the study. Seeds were sown and covered with soil in the greenhouse and watering was done regularly. These edlings were transplanted after 22 days. For the grow bag filling, potting mixture comprising of sand, soil and cow dung in the ratio of1:1:1 was mixed thoroughly after sprinkling water. Then a hole of 25 mm size to insert a wick was made at the bottom of bag.

Grow bag was filled up to one third volume and made into round shape by inserting the corners inside. Wick was then inserted into the bag through the bottom of hole in such a way that one-third of length of wick is projected outside the bag. There after the bag was filled up to desired depth. Empty water bottles of two litres capacity were used as water container for the installation of wick irrigation system. Two holes of 25mm size were made on the bottle, one hole is at 3-3.5 inch above the bottom for inserting the wick and other one near to the neck of the bottle for filling water. Bottle cap was made full tight and the bottle was placed in between two country bricks in such a way that the holes are facing up. The filled grow bag, containing wick was placed above bottle supported by two bricks and the wick was inserted into the hole on the bottom of the bottle. The statistical design selected for the study was complete block design (CBD) with four treatments and six replications. The design was done in such a way that each row contains six replications of one treatment. The field level set up of the experimental plot is shown in [Fig-1] and schematic representation of the experimental layout is shown in [Fig-2].

Fig-1 Field level setup of the experimental plot.

T_1R_1	T_1R_2	T_1R_3	T_1R_4	T_1R_5	T_1R_6
T_2R_1	T_2R_2	T_2R_3	T_2R_4	T_2R_5	T_2R_6
T_3R_1	T_3R_2	T_3R_3	T_3R_4	T_3R_5	T_3R_6
T_4R_1	T_4R_2	T_4R_3	T_4R_4	T_4R_5	T_4R_6

Fig-2 Schematic representation of the experimental plot

T_1- wick made up of cotton material
T_2-wick made up of silk wool
T_3-wick made up of glass wool
T_4-control (manual irrigation with manual fertilizer application)

The performance of the wick irrigation system and the different wick materials were evaluated based on the following parameters.

- Water uptake by different wick material (volume per day)
- Moisture distribution by different wick material.
- Biometric observation such as height of the plant, stem girth, number of branches, root length, root lateral distribution, root wet weight and root dry weight
- Yield parameters total yield number of fruits and diameter of fruit

Results and Discussion

A field study was conducted to determine the performance of wick irrigation system and to compare the performance of different materials used for making wick. The experiment was conducted in two seasons. The first season was from May to August and the second season was from September to December, 2017.

Water uptake rate

The water uptake rate of each wick material was recorded daily. [Fig-3] shows the comparison of water uptake rate of different wick material during season 1. From the figure it could be seen that the water uptake rate was maximum in T3 (glass wool) which is on par with T1(cotton) and minimum water uptake rate in T2 (silk wool). [Fig-4] shows the comparison of water uptake rate of different wick material during season 2. From the figure it could be seen that the water uptake rate was maximum in T3, the wick made up of glass wool and minimum in T1, the wick made up of cotton. It was also observed that the water uptake rate of silk wool was increased during the second season when compared to first season.

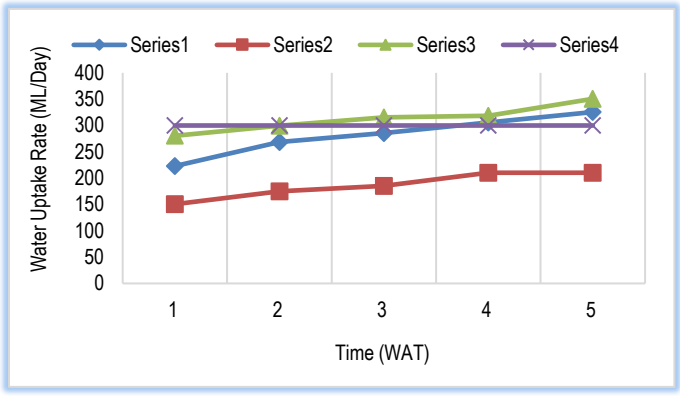

Fig-3 Graphical representation of water uptake rate in season 1

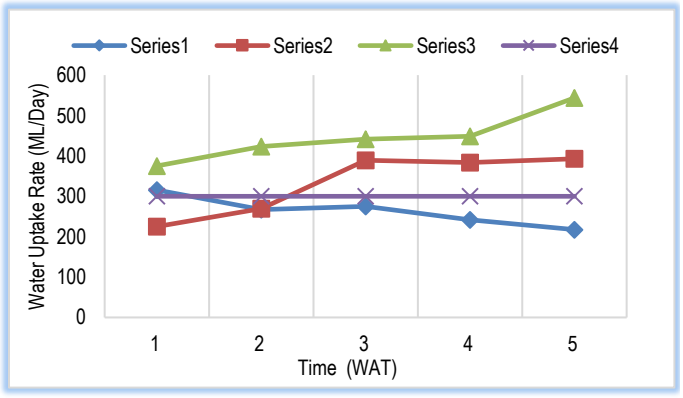

Fig-4 Graphical representation of water uptake rate in season 2

Moisture content

The comparison of moisture content of soil in different treatments during season 1 and 2 are shown in [Fig-5] and [Fig-6] respectively. It was found that the moisture content was maximum in T3 (glass wool) during both seasons and minimum inT2 (silk wool) during season 1and inT4 (control) during season 2. It was also showed that the moisture content in T1(cotton) was on par with T3 (glass wool).

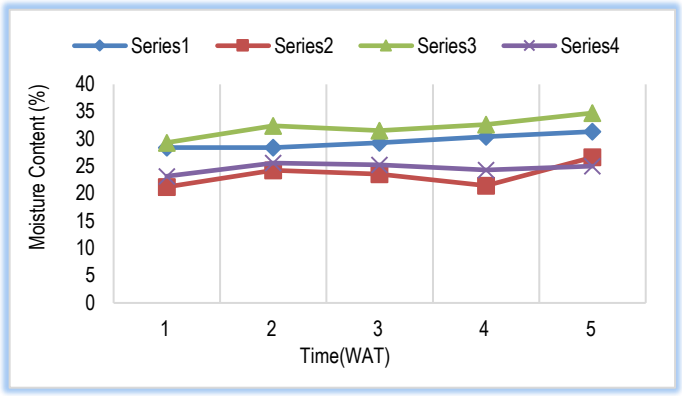

Fig-5 Graphical representation of moisture content in season 1

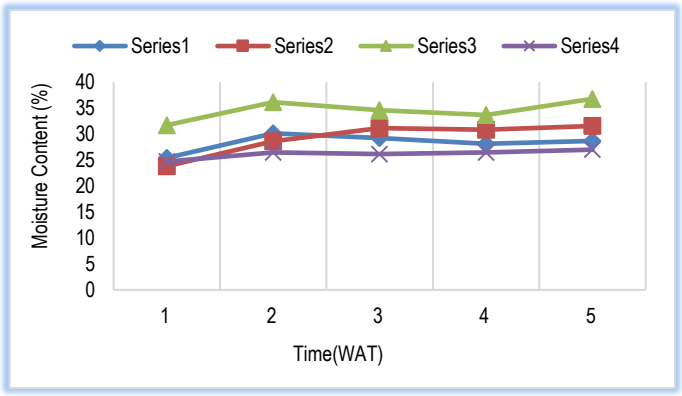

Fig-6 Graphical representation of moisture content in season 2

Measurement of biometric parameter

The growth parameters such as plant height, stem girth, number of branches, root length and root distribution were recorded during both seasons. The comparison of plant height, stem girth and number of branches of different treatments during seasons 1 and 2 are shown in [Fig-7]. From the figure it could be seen that all the above parameters were better in T3 (glass wool) and was on par with T1 (cotton) in season 1 and 2.T2 (silk wool) and T4 (control) showed lower performance of all biometric observations when compared to other treatments during season 1. Plant height and number of branches were more in case of silk wool (T2) during season 2 when compared to season1.

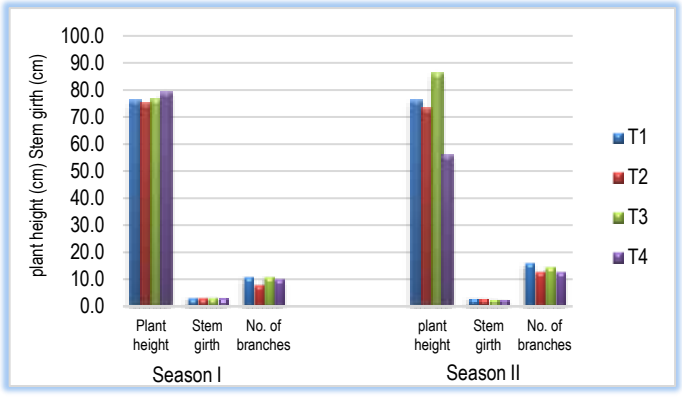

Fig-7 Comparison of growth parameters observed from season 1 and 2.

Root parameters such as root length, root distribution, root dry weight and root wet weight from different treatments were analysed and the results are shown in [Fig-8]. From the figure, it was found that the maximum root lengths of 51.92 cm and 62.50 cm were observed in T3 (glass wool) during season 1 and 2 respectively. The minimum root length of 24.75 cm and 26.35 cm were observed in T4 (control) during season 1 and 2 respectively.

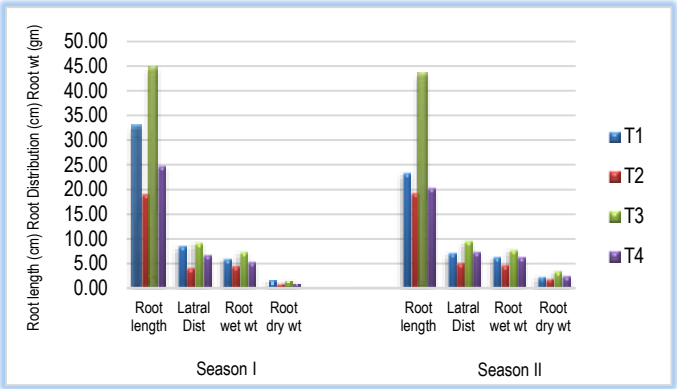

Fig-8 Comparison of root parameters observed from season 1 and 2.

In the case of lateral root distribution, the highest value of 10.25 cm and 11.52 cm were observed in T3 (glass wool) during season 1 and 2 respectively. The lowest root distribution of 4.30 cm and 6.31cm were observed in T2 (silk wool) during season 1 and 2 respectively. Similarly, the maximum root wet weight and dry weight were observed in T1 (cotton) and the minimum value was observed from T2 (silk wool) during season 1 and 2.

Measurement of yield parameter

The yield parameters such as total yield and fruit diameter were observed during both seasons. Harvesting was started from one month after transplanting. The yield responses were highly remarkable under different treatments. Total yield obtained from different treatments are represented graphically in [Fig-9].

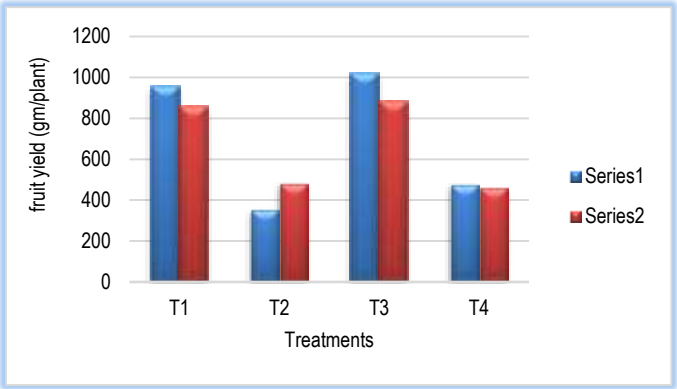

Fig-9 Graphical representation of fruit yield from different treatments

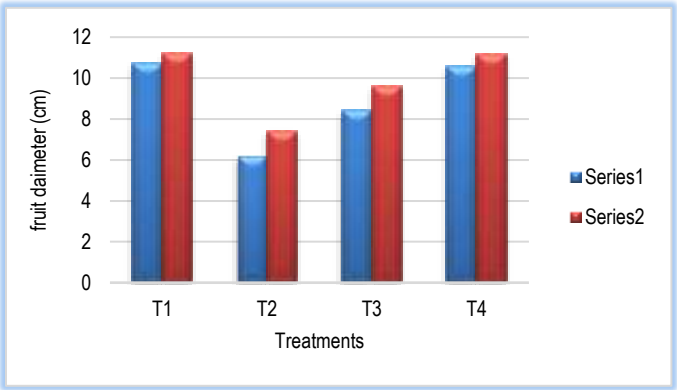

Fig-10 Graphical representation of diameter of fruits from different treatment

From the [Fig-9], it can be seen that the maximum average fruit yield was obtained from T3 (glass wool) which was 1020.00 gm during season 1 and 884.90 gm during season 2. The minimum fruit yield of 354.20 gm was obtained from T2 (silk wool) during season 1 and 463.00 gm was obtained from T4 (control) during season 2.

In the case of fruit diameter, the highest average fruit diameter was obtained from T1 (cotton) that is 10.75cm during season 1 and 11.16 cm during season 2. The lowest fruit diameter was obtained from T2 (silk wool) that was 6.21 cm during season 1 and 7.38 cm during season 2, as shown in [Fig-10].

Cost analysis of wick irrigation system

Cost of wick irrigation system includes installation cost, cost of wick, labour cost, cost for fertilizers and chemicals. The details of the cost analysis are given in [Table-1].

Table-1 *Comparison of cost economics of different treatments*

S	Item	Cotton (Rs)	glass wool (Rs)	silk wool (Rs)	Control
1	Seedlings	12	12	12	12
2	Wick	72	90	90	-
3	Manual fertiliser + chemical	15	15	15	15
4	Total labour cost (weeding+ fertilizer application + harvesting)	530	530	530	1436
5	Total cost of cultivation	629	647	647	1463
6	Yield/treatments (kg)	5.7	6.2	2.8	3
7	Yield (Rs)@ Rs 30/kg	171	186	84	90
8	Benefit Cost (B:C) ratio	0.323	0.28	0.13	0.064

From the table, it could be seen that the benefit-cost ratio of cotton wick is maximum *i.e.*, 0.323 as compared to other two treatments. The BCR of glass wool wick is on par with cotton wick *i.e.*,0.28. The BCR of control is minimum *i.e.*, 0.06. Thus, the wick irrigation system using cotton wick is found to be cost effective, when compared to other two treatments.

Conclusion

From the study, it could be concluded that the wick made up of glass wool (T3) showed better performance in biometric and yield parameters, water uptake rate and soil moisture on the soil. It was also observed that the wick made up of cotton(T1) was on par with the glass wool(T3). Considering the easy availability, eco-friendly nature of cotton and analysis of cost effectiveness, the cotton can be used as an alternative material for glass wool for making irrigation wicks.

Application of research: Wick irrigation method is cheap and at the same time water efficient. The scientific principle behind this method of irrigation is capillary action. So, this method of irrigation helps to wet the soil media at all time. There is no need of daily irrigation and also prevent over irrigation and under irrigation.

Research Category: Irrigation System

Abbreviations: cm-centimetre, Fig-Figure

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Cultivar / Variety / Breed name: Nil

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Ethical Committee Approval Number: Nil

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