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Studies on Irrigation Methods for Small Onion

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Abstract

Selecting the proper irrigation method will be more beneficial to manage irrigation in water scarcity areas and in dry lands to achieve the good crop growth and yield. The aim of this study was to evaluate the growth, yield performance of aggregatum onion under different irrigation system. This study was conducted in farmers field at Etchampatti village of Perambalur district. In this study two irrigation methods viz., furrow irrigation and laser spray irrigation (locally called as rain hose irrigation) were evaluated. The higher yield and good quality bulbs (bigger bulb size) were obtained in laser spray irrigation method. The incidence of sucking pest also reduced considerably in in laser spray irrigation method. Based on the growth and yield factors, it was found that in laser spray irrigation method for onion cultivation with of the water compared to furrow irrigation system. This might be due to in laser spray irrigation system allowing for more frequent and shallow irrigation with higher irrigation efficiency. The result might be due to the reasons Viz., 1) Onion is a less water requiring and very shallow rooted crop, shallow irrigation is enough for crop growth 2) It modifies the RH leads to less incidence of tip drying and better vegetative growth leads to better yield 3) Regular sprinkling of water over foliage will reduces the incidence of sucking pest.

Keywords: Small onion- irrigation – yield and energy saving efficiency– drought management

1. Introduction

Aggregatum onion (*Allium cepa* L. var aggregatum) is a universal significant crop due to its nutritional and medicinal properties (Ochar & Kim, 2023). Perambalur is one of the districts which cultivates aggregatum onion in large scale. The onions cultivated in Perambalur district were good in colour and highly pungent due to its nature of soil.

Now a days, the cultivable area of aggregatum onion is considerably reducing due to low rainfall and depilation of water table or water reservoirs. Drought significantly affects small onion production by reducing vegetative growth and yields, letting down the bulb quality and marketability. This can lead to considerable losses for farmers, especially in regions suffering prolonged dry spells. The Irrigation method of onion is directly related to profitable and sustainable onion production and onion needs frequent and light irrigation to maintain high soil moisture. The scarcity of irrigation water is an effective factor in reducing the cultivated areas in the world (Rao et al., 2019). Deficit irrigation of onions leads to water stress, which results in less leaf growth, a lower bulbing ratio, reduced bulb fresh weight, smaller bulb size, and decreased marketable yields (Al-jamal *et al*., 2001). So, there is a need of sourcing the method of irrigation to make use of the available water throughout the cropping period and to maintain the sufficient soil moisture to obtain more yield in the dry districts like Perambalur. Hence, there is a need for

modern irrigation system to save water from the farmers side and the researchers resorted to the development and use of new systems of micro irrigations to reduce wastage of water. In laser pipe irrigation, water sprinkled over the crop that imitate the small droplets of rainfall. The low rate of water delivery to the plant over time allows it to maintain the prime amount of irrigation required for maximum yield. Moreover, by this method the water can be saved upto 50- 70% depends on the soil and climatic condition. It is widely suitable for closely spaced crops like onion, vegetable crops, groundnut, etc. Currently, this technology mainly being adopted by onion cultivators. There is high chance of under and over irrigation in furrow irrigation leads to soil erosion, easy spread of disease, high soil moisture leads to disease susceptibility, loss in yield and loss of market grade, etc.

By keeping all those points, a study was conducted on evaluation of different method of irrigation in small onion to maintain the optimum soil moisture throughout the cropping period based on the plant need and getting more yield with less water at farmers field of Echampatti village of Perambalur district.

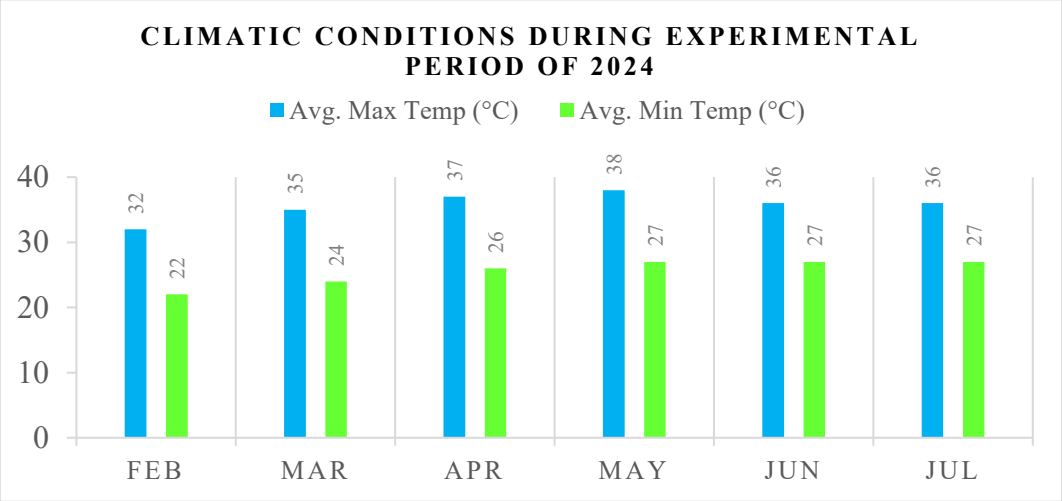
2. Materials and methods

2.1. Experimental area

The present work was carried out by Hans Roever Krishi Vigyan Kendra, Perambalur in farmers field at Echampatti village. Soils type of the trail site are classified as clay loam and the pH of the Soil is 6.5-7. Two methods of irrigation were compared T1- Furrow irrigation (Control), T2- laser spray irrigation (Rain hose irrigation) was tested in onion. The crop was raised for an area of 1 ac under each method of irrigation. These treatments were arranged in a Factorial Randomised Block Design (RBD) with four replications.

2.2. Climatic conditions during experimental period

Month	Avg. RF (mm)	Avg. Day light (Hrs)
Feb-24	8	11.8
Mar-24	11.3	12.1
Apr-24	28.2	12.4
May-24	46.3	12.6
Jun-24	34.3	12.8
Jul-24	40.8	12.7



2.3. Crop Details

Before transplanting of seedlings 25 kg N and 30 kg P_2O_5 and 25 K_2O was applied as the basal. The sources of N, P and K were Urea, Diammonium Phosphate (DAP) and Muriate of Potash (MOP) respectively. After 25 days 15 kg N and 10 kg P2O5 and 15 K_2O was applied as 1st top dressing. During 40th day, again 15 kg N and 10 kg P_2O_5 and 15 K_2O was applied as 2nd top dressing. Additionally, IIHR Vegetable special micro nutrient was applied @ 5g per liter at 25th and 35th day after sowing.

Before planting, the field was irrigated to maintain the soil moisture at field capacity. Disease free medium sized bulbs were selected, seed treatment has been done with Pseudomonas @ 5g/ Kg mixed in diluted rice cruel and sprinkled over the seed bulbs and thoroughly mixed on previous day night. Planting of bulbs were done in ridges and furrow method (both the sides of the ridges and top of the ridge) in last week of February, 2023. Ridges were formed with the spacing of 30 cm and the bubs were planted with the spacing of 10cm. The field has been irrigated immediately after planting. All other agronomic practices except irrigation method were kept even for all treatments. Mature onion bulbs were manually uprooted from the soil and cured in field for a week before taking yield parameters and storage.

For field preparation, field was ploughed with 7 tyne cultivator for 4 times and rotavator for one time. Before last ploughing, vermicompost @3 t/ acre, *Tricoderma viride* 2 kg / acre, Azotobacter 5 kg / acre, Neem cake 80 Kg/ acre along with CSR Bio 5 Kg / acre was applied as basal. The recommended dose of chemical fertilizers NPKS was 40:20:20:15 kg $acre^{-1}$. Fifty percent of N and 100% P, K and S applied at basal remaining 50% N applied in two splits at 30 & 45 days after transplanting furrow irrigation system. Whereas, in sprinkler irrigation system fertigation was done with drip tank in 7 splits with 7 days intervals per day 2-3 hr. First irrigation was operated immediately after transplanting and light irrigation was done three days after transplanting for better and uniform initial establishment of crop. Recommended crop production and protection practices were followed as and when required to get good healthy crop. Following critical precautions were taken while conducting the experiment viz. irrigation interval followed uniformly; the operating pressure of drip system was 1.0 -1.5 kg cm-2. In both the systems, irrigation was stopped at 15-20 days before crop harvesting. The bulbs were harvested at full maturity stage. After proper curing and neck cutting, the observations on yield and yield contributing characters and marketable bulb yield, percent of A (>6.5 cm), B (4.5- 6.5 cm) and C (< 4.5 cm) grade bulbs on weight basis separately recorded and quantity of water applied was also measured.

2.4.Irrigation scheduling

The laser pipe / rain hose irrigation and conventional furrow irrigation method was taken for comparison in onion crop. The laser pipe / rain hose irrigation has 100meters length, 40 mm in hose diameter, thickness 350 micron and 1 l/min/m flow rate while operating pressure 1 kg/cm^2. Around 12 rolls were used to cover one acre of onion field and the distance between two rain hose laterals were 8 feet. In laser pipe / rain hose irrigation system water is applied at depletion of 50 % soil moisture i.e the crop was irrigated once in 5 days (varies depends on soil moisture). The land area was divided in to 8 comportments with 4 valves to get the pressure flow rate and each comportment irrigated for 30 min. Collectively, the laser pipe / rain hose irrigation takes four hours to irrigate an acre of land area. In furrow irrigation method, water is delivered at the head and through gravity flows to tail end. Irrigation was provided at 50 % water depletion of field capacity, approximately the crop was irrigated once in 7 days (varies depends on soil moisture).

3. Result and Discussion

3.1. Influence of irrigation methods on growth and yield parameters of small onion

The plant height (cm) was recorded once in a week. The results revealed that the highest average plant height of 37.31 cm, 34.58 cm was recorded in laser pipe / rain hose irrigation during masi pattam i.e Feb- March and vaikasi pattam i.e May- June. Whereas, the furrow irrigation recorded comparatively lowest average plant height of 28.66 cm, 23.64 cm during Feb- March and May- June respectively. The No.of leaves and leaf thickness were also higher in laser pipe / rain hose irrigation method (6.17cm, 1.23 cm; 5.77, 1.02) and the lowest values were recorded in furrow irrigation (5.33, 1.12 cm; 4.94, 0.96 cm) respectively during Feb- March and May- June.

The results indicated that in laser pipe irrigation in ridges and furrow system, the plant can receive favourable conditions for formation of profuse root system thereby plant growth and vigour is high. The same findings were reported by Bhonde et al. (2003); Kumar et al. (2007) and Bangali et al. (2012) for plant growth. Laser pipe irrigation provided require amount of water to the crop at frequent intervals as needed by the plant with a lower expulsion rate not more than the infiltration rate of soil (Ramaha et al. 2011).

The drip irrigation affected the size of onion bulb, highest bulb diameter of 4.21 cm, 3.94 cm were recorded in rainhose irrigation during Feb- March and May- June and the lowest bulb diameter of 3.58 cm, 3.67 cm were recorded from the surface irrigation during Feb- March and May- June, respectively. Frequent amount of soil moisture application leads to large photosynthesis area resulted highest plant height and large number of leaves leads to large bulb diameter (Basker et al., 2018).

3.2. Irrigation water and yield relations

The highest total bulb yield of 18.24 t per hector and 17.81 t per hector were recorded in rain hose irrigation system in both Feb- March and May- June, whereas as in furrow irrigation lowest bulb yield were recorded during both Feb- March and May- June viz., 15.12t per ha and 14.97 t per hector (Table. 1). The yield over furrow method of irrigation were 20.63% and 18.97% (Table.3), respectively during Feb- March, May- June. Onions require frequent, light irrigation because of shallow root systems, frequent irrigation is important for achieving high yields and uniform bulbs. The light irrigation also reduces the fungal infection leads to more of marketable bulbs. Rain hose irrigation with fertigation of NPK nutrients with regular intervals enables better plant growth caused higher photosynthesis levels and higher carbohydrates accumulation in sink region. It is evidenced from the results presented in this study is inclusive and similar with previous researchers (Balasubramanyan et al. 2001; Quadir et al. 2005; Tripathi et al. 2010; Bangali et al. 2012).

Table. 1. Productivity Gains through different methods of irrigation in 2 seasons

S. No	Method of irrigation	Plant Height		No. of leaves (Nos)		Leaf thickness		Bulb size (cm)		Yield (t ha^{-1})	
		Feb-March	May-June	Feb-March	May-June	Feb-March	May-June	Feb-March	May-June	Feb-March	May-June
1.	Furrow method of irrigation	28.66	23.64	6. 51	6.14	1.02	0.96	3.58	3.67	15.12	14.97

2.	Rain hose irrigation	37.31	34.58	7.87	7.33	1.23	1.12	4.21	4.14	18.24	17.81
	Sed	0.11		0.13		0.03		0.06		0.43	
	CD (0.05)	0.24		0.29		0.07		0.13		0.95	

Table. 2. Water and energy saving efficiency of different methods of irrigation

S. No	Method of irrigation	No. of irrigation		Water consumption		Electricity consumption (kw)		Labour consumption only for irrigation	
		Feb-March	May-June	Feb-March	May-June	Feb-March	May-June	Feb-March	May-June
1.	Furrow method of irrigation (running 8hours to irrigate an acre)	8	10	16 lakh litters	20 lakh litters	238.72	298.4	16	20
2.	Rain hose irrigation (running 3 hrs to irrigate an acre)	12	15	9 lakh litters	11 lakh litters	134.28	167.85	1	1

Table. 3. Efficiency of rain hose irrigation over Furrow method of irrigation

S. No	Particulars	Feb- March	May- June
1.	Yield increases over furrow method of irrigation	20.63%	18.97%
2.	Energy (Water and electricity) saving over furrow method of irrigation	43.75 %	45.00%
3.	Labour saving Percentage	93.75%	95.00%

3.4.Energy saving efficiency

The average volume of irrigation water applied was 9 lakh litters during February- march, 11 lakh litters in May- June under Rain hose irrigation method (Table. 2). The amount of water applied in the conventional furrow method of irrigation were 16 lakhs litters during February- march, 20 lakhs litters in May- June, which is 43.75% (February- march), 45.00% (May- June) more than that applied in rain hose irrigation (Table. 3).

Through rain hose irrigation, the file gets irrigated maximum up to 10- 15 cm, which reduces seepage and evaporation losses in conveyance, reduces deep percolation over furrow irrigation, improves water use efficiency. Same has been reported by water applied at appropriate times can some-times make additional contributions to improved crop production besides the replenishment of water content.

4. Conclusion

Employing rain hose irrigation system not only saving the irrigation water upto 45% but also led to more

yield of 18-20% and can obtain deep colour good quality bulb formation compared to the conventional furrow method of irrigation. Through the water saving we can improve the cropping area in the water deficit or frequent dry spell occurring area.

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