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Research Paper :

Response of onion (*Allium cepa* L.) to irrigation schedules and nitrogen levels under micro-irrigation system

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ABSTRACT

An experiment was conducted at College of Agricultural Engineering and Technology, MAU, Parbhani to assess the response of onion under different irrigation schedule and nitrogen levels under micro irrigation system. In the present investigation onion variety N-53 was tested for exploiting its maximum yield potential under four irrigation schedules namely I_1 (0.75 Etc), I_2 (1.00 Etc), I_3 (1.25 Etc) and I_4 (conventional check basin)and three nitrogen levels namely N_1 (75 % RDF of N), N_2 (100 % RDF of N) and N_3 (125 % RDF of N). The performance of drip irrigation system was judged by uniformity of distribution and emission uniformity. The water use efficiency and fertilizer use efficiency was also studied. The average emission uniformity coefficient of drip irrigation system was 95.07 per cent. The highest yield of onion bulb was obtained in the plots with drip irrigation method scheduled at 1.25 Etc mm depth and 100 per cent recommended dose of nitrogen.

Key words : Irrigation scheduling, Micro irrigation, Emission uniformity, Yield of onion

As the water is scarce, it is essential to use it more efficiently by the way of adopting proper scheduling and water saving method such as micro irrigation methods for fetching higher yields and water use efficiency. Onion (*Allium Cepa* L.) is an important vegetable cash crop in India. India has largest area under onion in the world. Onion is an important and indispensable item in every kitchen as condiment and vegetable. Onion is used either in salad or as condimentor for cooking with other vegetables. It has good medicinal value. It's major value lies in it's flavour. Onion is most sensitive to irrigation. Onion has a relatively shallow root zone and hence requires more frequent irrigations as compared to other vegetable crops. Under such circumstances, drip irrigation is a promising technology by which water is conveyed under pressure through a pipe to a relatively closely spaced grid of outlets and discharging the water through these outlets at virtually zero pressure (Chopde and Bansode,1995). The application of fertilizers through drip irrigation system is relatively a new practice in India (Maher, 1991). Keeping all above points in mind, the field experiment was planned, to determine appropriate irrigation schedule for onion under drip irrigation system, to assess the response of onion under different nitrogen level.

METHODOLOGY

The experiment was conducted at College of Agril. Engg. and Technolgy, MAU, Parbhani to study the response of onion (variety N-53) under different irrigation schedule and fertilizer levels under micro irrigation system.

Experimental details		
a	Crop	Onion
b	Botanical name	*Allium cepa L.*
c	Variety	N-53
d	Experimental design	Split plot
e	Number of replications	Three
f	Number of treatments	Twelve
g	Number of plots	36
h	Plot size	3 x 4.5 m
I	Crop spacing	10 x 15 cm
j	Seed rate	10 kg ha^{-1}
k	Fertilizer dose	100:50:50 as N:P:K

Details of treatments:

Treatments constituted the combination of four irrigation schedules and three nitrogen levels) Main treatments

I_1 - Irrigation at 0.75 ETc through micro irrigation.
I_2 - Irrigation at 1.00 ETc through micro irrigation.
I_3 - Irrigation at 1.25 ETc through micro irrigation
I_4 - Surface irrigation (conventional check basin).
B) Sub treatments
N_1 - 75% recommended dose of N.
N_2 - 100% recommended dose of N.
N_3 - 125% recommended dose of N.

All these treatment were tested in split plot design with there replications.

Emission uniformity:

The emission uniformity is essential for determination of total depth of irrigation. An efficient irrigation system must apply water uniformly through out field

The emission uniformity and average discharge was calculated by following equation.

$$EU = \frac{1}{2}\left[\frac{Q_{min}}{Q_{avg}} + \frac{Q_{avg}}{Q_{max}}\right] X\ 100$$

In which,

Eu - Emission uniformity (%)

Q_{min} - Minimum discharge (lph)

Q_{avg} - Average emitter discharge (lph)

Q_{max} - Average of the highest $1/8^{th}$ of emitter discharge (lph)

Bulb yield:

The weight of onion bulb along with the stalk from the representative area of each plot was recorded. Then the bulbs were separated from the stalk and the weight of bulbs from representative area of each plot was recorded.

Water use efficiency:

Water use efficiency is the ratio of crop yield to the amount of water applied in the field, it was computed by using following equation:

$$WUE = \frac{Y}{WR}$$

in which,

WUE - Water use efficiency (t/ha mm)

Y - Yield of crop produced (t/ha)

WR - Irrigation water applied (mm)

Fertilizer use efficiency:

Fertilizer use efficiency is the ratio of crop yield to the amount of fertilizer use (kg) in the field; it was calculated using the equation as:

$$FUE = \frac{Y}{FR}$$

in which,

FUE - Fertilizer use efficiency (t/ha kg)

Y - Yield of crop produced (ton/ha)

FU - Fertilizer use (kg)

RESULTS AND DISCUSSION

The findings of the present study as well as relevant discussion have been summarized under following heads:

Emission uniformity:

The emission uniformity of the system was determined by adopting standard procedure and represented in Table 1. Data presented in Table 1, reveals that coefficient of uniformity (EU) was 95.07 per cent which is good enough for any micro-irrigation system. The emission uniformity coefficient was in the range of 92.36 to 96.38 per cent.

Table 1 : Emission uniformity of drip irrigation system

Treatments	Emission uniformity, per cent			
	N_1	N_2	N_3	Mean
I_1	94.33	92.36	96.38	94.35
I_2	95.32	96.12	94.97	95.47
I_3	95.83	94.87	95.53	95.41
Mean	95.16	94.45	95.62	95.07

Onion bulb yield:

The data regarding the effect of irrigation schedules and nitrogen levels on onion bulb yield are presented in Table 2. Data in Table show that the mean yield of onion bulb was higher (89.2 t ha^{-1}) in treatment I_3N_2 (1.25 ETc depth and 100% RD of N) where as the minimum yield (48.6 t ha^{-1}) was observed in treatment I_4N_3 (Convential check basin method 1.25% RD of N). Similar results were reported by Kumar *et al.* (2001) in onion.

Table 2 : Interaction effect of irrigation schedule and nitrogen level on onion bulb yield

Treatments	Onion bulb yield (t ha^{-1})			
	N_1	N_2	N_3	Mean
I_1	78.3	81.5	65.1	74.9
I_2	80.1	84.2	76.3	80.2
I_3	82.0	89.2	81.1	84.1
I_4	59.6	53.5	48.6	53.9
Mean	75.0	77.1	67.8	73.3
S.E.±		4.49		
C.D. (P=0.05)		13.46		

Irrigation water use efficiency:

Water use efficiency was estimated using fresh onion bulb yield and irrigation water applied for different treatments and presented in Table 3. Data present in table

Table 3 : Water use efficiency of onion under different treatments

Treatments	Water use efficiency (t/ha/mm)			
	N_1	N_2	N_3	Mean
I_1	0.27	0.28	0.23	0.26
I_2	0.23	0.25	0.23	0.23
I_3	0.20	0.22	0.20	0.20
I_4	0.11	0.09	0.09	0.09
Mean	0.20	0.21	0.18	0.19

revels that the maximum WUE was in treatment I_1 (0.75 ETc mm depth) was 0.26 t/ha/mm and it was decreased with increased depth of irrigation. The maximum water use efficiency was bound with frequent light irrigations. The higher WUE can be due to low depth of irrigation water applied. On the other hand increase in onion bulb yield resulted in higher WUE even if same quantity of water was applied

Nitrogen use efficiency:

Nitrogen use efficiency was estimated using bulb yield and amount of nitrogen applied for different treatments were determined and presented in Table 4. Data presented in Table shows that the maximum nitrogen use efficiency 2.80 t/ha/kg was in treatment I_3N_1 and the minimum nitrogen use efficiency (1.05 t/ha/kg) was in treatment I_4N_1. Thus the higher fertilizer use efficiency may be due to sufficiently higher yield obtained in I_3N_2 treatment even if the amount of nitrogen application was higher than N_1.

Table 4 : Nitrogen use efficiency (t ha^{-1}kg^{-1})

Treatments	Water use efficiency (t/ha/mm)			
	N_1	N_2	N_3	Mean
I_1	2.67	2.54	1.87	2.36
I_2	2.73	2.63	2.19	2.51
I_3	2.80	2.78	2.33	2.63
I_4	1.05	1.67	1.39	1.37
Mean	2.31	2.41	1.94	2.22

Conclusion:

The average emission uniformity coefficient of drip irrigation system was 95.07 per cent. The highest yield of onion bulb was obtained in the plots with drip irrigation method scheduled at 1.25 ETc mm depth and 100 per cent recommended dose of nitrogen. The water use efficiency decreased with increase in depth of irrigation water applied.

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