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National Academy of Agricultural Science (NAAS) Rating : 3.03

Effect of Drip Irrigation on Onion (*Allium cepa*) Seed Production under Western Maharashtra Conditions

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ABSTRACT: *An experiment was conducted at Directorate of Onion and Garlic Research, Rajguru Nagar, Pune, Maharshahtra during 2009-2012 to study the feasibility and economic viability of different levels and frequency of drip irrigation in comparison with flood irrigation on growth, yield and yield contributing characters of onion seed crop under western Maharashtra conditions. The experiment results revealed that, there was significant effect on growth, yield and yield contributing characters of onion seed crop as influenced by different methods and levels of irrigation practices. Among the different methods, levels and frequency of irrigation evaluated, drip irrigation at 100% PE daily improved the growth, yield and yield contributing parameters. With regards to yield, among the drip irrigation treatments and frequency, the higher seed yield was recorded at drip irrigation at 100 PE (582.6 kg/ha) in daily interval followed by drip irrigation at 100% PE daily (506.4 kg/ha) interval. Moreover, it was clearly indicated from the experiment results that the saving of irrigation water was to the tune of 37.5 % in drip system under best treatment as compared to surface irrigation, when it was scheduled at 50mm CPE with 7 cm depth.*

Key words: *Onion seed, drip, surface irrigation, growth, yield, water.*

INTRODUCTION

Onion (*Allium cepa* L.) is commercially cultivated and widely consumed as vegetable crop in India. It is an important commodity from export point of view too. India though ranks second in area and production, the productivity is quite low (15.6 t/ha) as compared to other onion producing countries like China, USA and Turkey, where their productivity ranged from47-60t/ha [Pandey *et al*) [6].One of the main reason for low productivity in onion crop is unawareness of the farmers about good quality seed production techniques particularly improved agronomic practices like micro irrigation, fertigation, use of micronutrients, growth regulators..etc. Flood or surface irrigation method is widely practiced in India results in inefficient use of irrigation water due to losses in evaporation, deep percolation and distribution, while water use efficiency of properly designed and managed micro irrigation system about 90 per cent. Many attempts have been made to use of improved agronomic practices in onion bulb crop not in seed crop. Among the various inputs applied to onion, irrigation water is crucial one. Shortage of irrigation water at critical stages of onion seed crop reduces yield significantly. Appropriate use of irrigation system with higher water use efficiency further elevates productivity. Micro irrigation particularly drip irrigation ensures higher water use efficiency. Several research workers reported that through micro irrigation, higher crop yields can be obtained along with considerable saving in irrigation water (Bhakre and Fatkal [2], Kumar *et al* [5]).While anticipating dyre need increasing the productivity and also saving in irrigation water in future, an experiment was conducted at Directorate of Onion and Garlic Research, Rajguru Nagar, Pune, Maharashtra to study the feasibility of different levels and frequency of drip irrigation in comparison with flood irrigation on growth, yield and yield contributing characters of onion seed crop under Western Maharashtra conditions.

MATERIALS AND METHODS

The experiment was carried out during *rabi* season from 2009-2012 in a randomized block design with three replications. The soil of the experimental site was clay loam in texture and had pH of 7.48, electrical

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conductivity 20.8mS/m, with field capacity of 20.1% and permanent wilting point of 8.4%.The onion variety used in the experiment was N-2-4-1 and bulbs were planted in broad based furrow (BBF) of 120 cm top width and 1.50 bottom width and bulbs were planted at a spacing of 30 cm and spacing between two bulbs in row was kept as 60 cm. Each planted bulbs row consists of one drip lateral (16mm size) with inbuilt emitters. The distance between two inbuilt emitters was around 30 cm and the discharge flow rate is 4L/hr. The treatments comprised of drip at 75, 100 and 125% PE with a frequency of daily, 3,7 and 10 days interval along with surface irrigation on 7 cm at 50 mm CPE as a control.

The drip was operated daily based on daily pan evaporation rate. The volume of water to be given on alternate days through drip was calculated as V = PE x PF x KC x Spacing (dripper spacing x lateral spacing) x Wetted area factor divided by system efficiency. Where, V - Volume of water applied; PE - Pan evaporation,; PF – Pan Factor; KC – Crop Factor (based critical stages of crop growth) as per FAO Irrigation water management training manual No.3 (1983). And running time (RT) was calculated as author, RT = Volume of water applied divided by No. of drippers x dripper discharge rate. The operating pressure of drip system was maintained @ 1.0 kg/ cm^2. The performance of drip systems in each treatment plot were excellent as the emission uniformity of the system was exceeded to 90 per cent. In control plot, the surface irrigation was given when CPE reaches 50mm at 7 cm depth of soil by using replogal flume meter. The recommended fertilizer doses were given as per schedule. 50 per cent fertilizer dose of N (as urea) was applied as a basal dose and remaining 50 percent dose was divided in seven equal doses and applied at ten days interval through drip irrigation after planting of bulbs. Full dose of Phosphorus and potassium were applied as single super phosphate and muriate of potash as basal dressing at the time of BBF preparation. The recommended plant protection measures were taken as and when required. The irrigation was stopped at 10 days before harvesting of onion seed from umbels. The umbels were harvested at maturity stage and seeds were separated carefully. Observations on plant morphological characters, yield and yield contributing characters were recorded and quantity of water applied was also worked out. The collected data were statistically analyzed according to the methods suggested by Panse and Sukhatme [7].

RESULTS AND DISCUSSION

There was significant effect on growth, yield and yield contributing characters of onion seed crop as influenced by different methods and levels of drip irrigation practices. (Table 1-2). Among the different methods and levels of irrigation evaluated, Drip irrigation at 100%PE recorded the highest umbel height followed by drip irigation at 100% pan evaporation for 3 days once (Table 1). Plant height is an important yield attribute in onion. Any practice to alter the plant height would influence the economic yield in onion. Plant height has a direct relation with seed yield. In the present experiment, the increased plant height in drip irrigated plots might be due to better availability of moisture during entire crop growth period favoured the growth attributes. Almost similar trend was noticed in number of umbels per plant. Irrespective of levels and frequency, drip irrigation method at different intervals of application noticed the higher number of umbels. The increased growth attributes might have supplied water and nutrients in adequate proportion, which resulted in triggering the production of plant growth hormone, *viz*. Indole Acetic Acid (IAA) throughout the cropping period. The umbel polar and equatorial diameter (Fig. 1a) seed weight per plant and seed yield were significantly improved by drip irrigated plots compared to surface irrigation. This is in line with earlier finding of Tomar [9].

In drip irrigation system, water is applied at a low rate for a longer period at frequent intervals near the plant root zone through lower pressure delivery system. It increased the availability of nutrients near the root zone with a reduction in leaching losses. More nutrient availability especially near the root zone might have increased the translocation of photosynthates to storage organ of bulb resulting in an increased diameter and weight of bulb. Similar results were also obtained by Kumar *et al* [5]. The increased per cent of more seed yield under drip irrigation may be attributed to better water utilization, higher uptake of nutrients, decreased salt in root zone, excellent soil water air relationship with higher oxygen concentration in root zone and maintained soil moisture at a constant level (Manjunatha *et al.*) [4].

The highest seed yield (582.6 kg/ha) of onion var-N-2-4-1 was noticed in drip irrigation at 100% PE daily followed by drip irrigation at 100 % PE 7 days once (506.4 kg/ha)(Table 2). This confirms the earlier findings of Sankar *et al.* [8] and Dingre *et al.* [3] who also recorded the higher marketable bulb and seed yield of onion under drip irrigation system. In the

Table 1
Effect of drip irrigation intervals and frequency on growth and seed yield of onion Var.N-2-4-1

Treatment details	*Umbel height (cm)*			*Pooled mean*	*Number of umbels/ plant*			*mean*	*PooledSeed weight per plant(g)*			*Pooled mean*
	09 -10	*10-11*	*11-12*		*09-10*	*10-11*	*11-12*		*09-10*	*10-11*	*11-12*	
75% PE Daily	76.2	74.2	73.2	74.5	6.7	4.1	5.1	5.3	6.4	16.2	7.8	10.1
75% PE 3 days Interval	72.5	74.9	74.1	73.8	7.7	4.0	4.3	5.3	5.4	20.7	6.3	10.8
75% PE 7 days Interval	72.0	75.9	69.7	72.5	6.2	5.1	4.5	5.3	5.5	19.5	7.0	10.7
75% PE 10 days Interval	73.7	76.7	73.5	74.6	7.3	5.5	5.4	6.1	5.9	16.9	6.5	9.8
100% PE Daily	85.4	82.3	70.2	79.3	7.5	5.7	4.2	5.8	6.7	28.5	6.9	14.0
100% PE 3 days Interval	81.2	84.0	70.0	78.4	7.1	5.1	4.2	5.5	5.2	24.0	7.4	12.2
100% PE 7 days Interval	70.9	79.8	70.1	73.6	7.6	5.1	3.9	5.5	5.2	17.8	7.2	10.1
100% PE 10 days Interval	72.0	81.5	71.1	74.9	6.9	5.5	5.1	5.8	6.0	20.0	8.1	11.4
125% PE Daily	70.0	79.1	75.1	74.7	6.2	5.6	4.7	5.5	4.7	23.8	7.5	12.0
125% PE 3 days Interval	69.1	77.4	70.9	72.5	6.5	5.2	4.0	5.2	4.5	20.1	7.3	10.6
125% PE 7 days Interval	69.5	76.7	76.9	74.4	6.8	4.5	4.3	5.2	3.7	22.4	7.0	11.0
125% PE 10 days Interval	68.9	75.3	69.3	71.2	7.7	4.4	4.1	5.4	3.5	18.6	6.1	9.4
Surface Irrigation at 50mm CPE	68.6	76.3	67.7	70.9	6.7	4.7	4.3	5.2	5.6	20.9	2.3	9.6
SEm+	3.18	2.73	2.57	2.02	0.66	0.68	0.83	0.32	0.75	4.04	0.78	1.24
CD(P=0.05)	9.23	5.64	5.30	NS	NS	1.40	1.70	NS	NS	8.35	1.61	NS

Table 2
Effect of drip irrigation intervals and frequency on growth and seed yield of onion Var.N-2-4-1

Treatment details	*Seed yield / plant (kg/ha)*			*Pooled mean*	*Water use efficiency (%)*			*Pooled mean*
	09-10	*10-11*	*11-12*		*09-10*	*10-11*	*11-12*	
75% PE Daily	426.6	573.0	338.8	446.1	8.02	11.5	11.6	10.4
75% PE 3 days Interval	359.7	731.8	275.7	455.7	6.76	14.7	9.47	10.3
75% PE 7 days Interval	365.0	689.6	305.2	453.3	6.86	13.9	10.5	10.4
75% PE 10 days Interval	393.6	596.2	285.3	425.0	7.40	12.0	9.80	9.7
100% PE Daily	443.7	1004.4	299.6	582.6	6.26	15.1	10.3	10.6
100% PE 3 days Interval	349.7	847.4	322.0	506.4	4.93	12.8	8.30	8.7
100% PE 7 days Interval	346.6	629.8	315.6	430.7	4.89	9.48	8.13	7.5
100% PE 10 days Interval	399.6	705.9	355.0	486.8	5.64	10.6	9.15	8.5
125% PE Daily	311.7	839.0	326.9	492.5	4.40	10.1	6.75	7.1
125% PE 3 days Interval	297.7	709.9	317.3	441.6	3.36	8.55	6.56	6.2
125% PE 7 days Interval	249.4	790.9	306.1	448.8	2.81	9.53	6.32	6.2
125% PE 10 days Interval	234.7	656.3	267.5	386.2	2.65	7.91	5.53	5.4
Surface Irrigation at 50mm CPE	375.8	736.2	119.7	410.6	3.85	7.01	3.06	4.6
SEm+	50.2	142.2	34.00	47.79	8.02	11.5	11.6	10.4
CD (P=0.05)	NS	294.9	70.18	NS	6.76	14.7	9.47	10.3

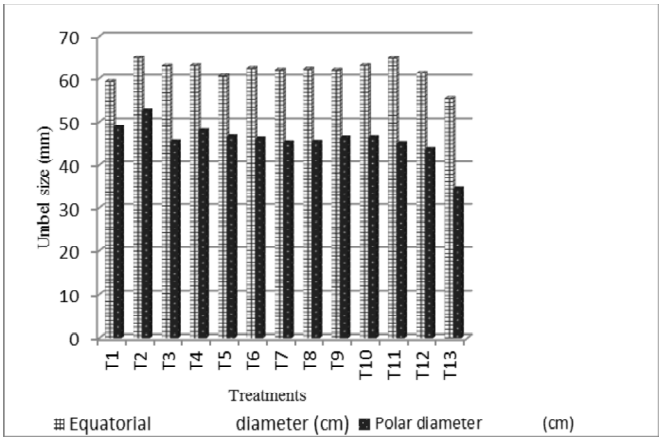

Figure 1a: Umbel size influenced by irrigation

(T1 - 75% PE Daily, T2-75% PE 3 days Interval,T3-75% PE 7 days Interval,T4-75% PE 10 days Interval,T5-100% PE Daily,T6-100% PE 3 days Interval,T7-100% PE 7 days Interval,T8-100% PE 10 days Interval,T9-125% PE Daily,T10-125% PE 3 days Interval,T11-125% PE 7 days Interval,T12-125% PE 10 days Interval,T13-Surface Irrigation at 50mm CPE)

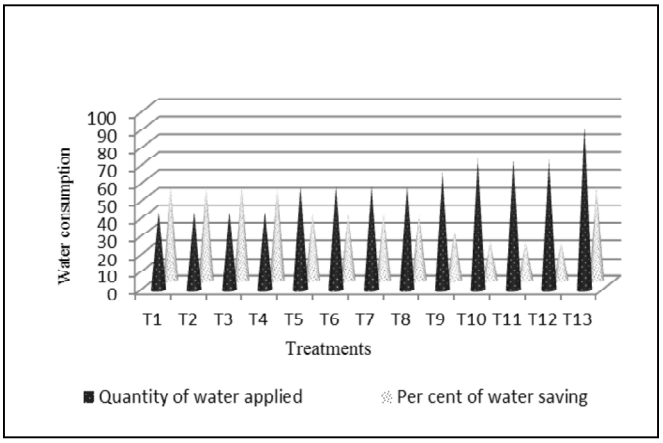

Figure 1b: Water utilization

(T1 - 75% PE Daily, T2-75% PE 3 days Interval,T3-75% PE 7 days Interval,T4-75% PE 10 days Interval,T5-100% PE Daily,T6-100% PE 3 days Interval,T7-100% PE 7 days Interval,T8-100% PE 10 days Interval,T9-125% PE Daily,T10-125% PE 3 days Interval,T11-125% PE 7 days Interval,T12-125% PE 10 days Interval,T13-Surface Irrigation at 50mm CPE)

present experiment, the increased yield in drip irrigation system was mostly due to the favourable effect of available soil moisture, uniform distribution of irrigation water during entire growth period and also more uniform size of seed forming umbels.

The lower yield in surface irrigation method could be attributed to inefficient use of irrigation water, deep percolation and uneven distribution of irrigation water. The minimum water was applied to drip irrigation at 75% PE and the maximum water applied to the surface irrigation method (Fig1b). It is clear from the data that water could be saved to the extent of 37.5 per cent in best treatment over surface irrigation system. Micro irrigation with limited water application seems to be a better alternative to improve onion seed production with reduced water (Bekele and Tilahub) [1].The present investigation revealed that the highest water use efficiency was observed in

drip irrigation system. Among the levels of irrigation tested, drip irrigation at 75% PE noticed the highest water use efficiency but there was a slight reduction in yield in comparison with drip at 100 % PE. On the basis of the three years results of the study, it can be concluded that drip irrigation practices significantly improved the growth, yield and water use efficiency of onion seed production under western Maharashtra conditions. Among the various methods, levels and frequency studied over a last three years, drip irrigation at 100% PE daily interval found to be superior in terms of improved growth characters, higher seed yield and water use efficiency than surface irrigation method.

REFERENCES

Bekele, S.,Tilahub, K. (2007), Regulated deficit irrigation scheduling of onion in a semiarid region of Ethiopia. Agricultural Water Management 89(1-2): 148-152.

Bhakre,B D and Fatkal Y.D. (2008), Influence of micro irrigation and fertilizer levels through fertigation on growth, yield and quality of onion seed. *Journal of Water Management* 16(1): 35-39.

Dingre, S. K., D. D. Pawar and K. G. Kadam. (2012), Productivity,water use and quality of onion (*Allium cepa*) seed production under different irrigation scheduling through drip. *Indian Journal of Agronomy* 57(2) : 186-190.

Manjunatha M V, Rajkumar G R, Hebbara M and Ravi shankar G. (2004), Effect of drip and surface irrigation on yield and water production efficiency of brinjal in saline vertisols. *Indian Journal of Agricultural Sciences* 74 (11): 583-7.

Kumar S., Imtiyaz M., Ashwani kumar and Singh R. (2007), Response of onion (*Allium cepa* L) to different levels of irrigation water. *Agricultural Water Management*. 89 (1-2): 161-6.

Pandey U B, Singh L and Bhonde S R. (2004), *Onion Production in India*. Technical Bulletin. Revised Second Edition, NHRDF, Nashik. pp2-3.

Panse, V G and Sukhatme P V. (1995), *Statistical Methods for Agricultural Workers*. Second edition, ICAR, New Delhi.

Sankar, V, Lawande K E and P C Tripathi (2008), Effect of micro irrigation on growth,yield and water use efficiency of onion (*Allium Cepa* L) under western Maharashtra conditions. *Indian Journal of Agricultural Sciences*, Volume 78(7) 584-588.

Tomar, B. S., Singh Bhalaaj, Maheshkumar and Hasen, M. (2004), Effect of irrigation method on the yield and quality of onion seed. Seed Research 32 (1) 45-46.