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Short communication

Response of drip irrigated onion crop to irrigation intervals and fertigation strategies

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ABSTRACT

A field study was conducted during 2008 and 2009 to investigate the yield response of onion (*Allium cepa* L.) to different irrigation intervals and fertigation strategies under drip irrigation. Two irrigation intervals and four fertigation strategies were evaluated. The plant height, bulb diameter and bulb weight were observed to be highest under the combination of two day irrigation interval with fertigation during second half of irrigation duration (I_1F_3). The highest yield (34.50 t/ha) was also recorded in the same treatment. The crop water use efficiency (CWUE) and irrigation water use efficiency (IWUE) were highest in the I_1F_3 treatment. Field data revealed that the I_1F_3 was found to be the best among all the treatments.

Key words: Drip irrigation, fertigation, onion.

Onion which is a member of Amaryllidaceae family is an important crop in India and an essential component of the daily diet. India's average productivity of onion is 16.41 t/ha which is lower than world's average of 20.08 t/ha (FAO, 2). Drip irrigation makes the best use of water for agriculture through enhanced irrigation efficiency. Higher crop yields and water use efficiency (WUE) could be achieved in drip irrigation as compared to surface irrigation (Rajput and Patel, 7). Study has been conducted to examine the irrigation criteria for drip irrigated onions and the best yields were observed when soil was constantly moist (Martin de Santa Olalla *et al*., 4). Irrigating twice in a week instead of once resulted in an increase of the water storage throughout the whole root zone, better crop water availability and higher yield (Mermoud *et al*., 5). There is need to identify the most suitable irrigation and fertigation strategy to enhance onion productivity. Keeping in view these knowledge gaps, this study was initiated to evaluate the performance of onion crop under different irrigation schedules and fertigation strategies.

The field experiment was conducted at Water Technology Centre, Indian Agricultural Research Institute, New Delhi, during January to May in 2008 and 2009. The soil type of the experimental site was sandy clay loam, low in organic matter (0.25%) with neutral pH (7.1). The available N, assimilable P and exchangeable K were 87.45, 25 and 195 kg/ha, respectively. The average field capacity value of root zone was 25.60% (by volume) and average permanent wilting point was 8.07% (by volume). The rainfall during the two cropping seasons was 176 and 28 mm, respectively. The mean monthly evaporation ranged from 2.9 to 5.6 mm and from 3.5 and 6.6 mm in the respective cropping season. Two-month-old seedlings of onion (var. Pusa Madhavi) were transplanted in second week of January during both 2008 and 2009 with standard spacing. The experiment was laid out in a split plot design having irrigation treatments as 2 day irrigation interval (I1) and 4 day irrigation interval (I2) and four fertigation treatments namely fertigation during first half of irrigation duration (F1), fertigation during throughout irrigation duration (F2), fertigation during second half of irrigation duration (F3) and fertigation during middle half of irrigation duration (F4) combining eight treatments. The irrigation treatments were in main plot whereas the fertigation treatments were in subplot treatment each with three replications. The plot size for the each replication was kept 2.4 m × 5 m. The dripper to dripper distance was kept 50 cm and lateral to lateral distance was kept 60 cm with 4 lph dripper discharge rate. Onion was harvested in the last week of May for both the years. The growing period of onion was 135 days from transplanting to harvesting. Before transplanting, 25 t/ha of FYM was applied to the field. The standard dose of N, P, K and S was applied for the onion crop and it was divided in 12 doses with 8 days fertigation interval. Fertigation was started 15 days after transplanting and stopped 30 days prior to the end of crop period. The crop evapotranspiration (ETc) was calculated by using the Penman-Monteith

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equation. Crop water requirement was 395 and 391 mm in 2008 and 2009, respectively. The irrigation requirement was 310 and 370 mm in 2008 and 2009, respectively. The irrigation requirement in 2008 was less compared to 2009, because of heavy rainfall in 2008 (176 mm). Observations on growth and yield parameters were taken at harvesting. The crop water use efficiency, irrigation water use efficiency was worked out as performance parameters. Statistical analysis was done by using MSTAT-C software with level of significance of 0.05 for determination of least significant difference (LSD).

The coefficient of variation (CV) was low which indicated good performance of the system throughout the cropping season. The values of statistical uniformity (SU) and distribution uniformity (DU) were 90.83 and 85.98%, respectively in 2008 and 92.79 and 89.48% in 2009 implied an excellent functioning of the drip system.

The bulb diameter and bulb weight of onion was found to be highest in I1 for both the seasons (Table 1) with difference between I1 and I2 was non-significant. The plant height was found highest in I1 and it was significantly different from I2 during both the seasons. The effect of irrigation frequency on the growth parameters have been investigated by Hanson *et al*. (3). The study reported that the less interval between the irrigations helps to keep active root zone moist which leads to proper growth of onion plant. Irrespective of the irrigation treatments, the plant height, bulb diameter and bulb weight was measured at the time of harvesting under fertigation treatment and was found highest in F3 (Table 1). Also, there was significant difference between the plant height, bulb diameter and bulb weight under F3 and other fertigation treatments. The statistical analysis revealed that the fertigation strategies have significant effect on the growth parameters of the onion crop. The combined effect of irrigation interval and fertigation strategies was also investigated on the onion crop growth parameters (Table 1). The plant height was highest in I1F3 treatment with significant difference between the other treatments. The individual bulb diameter was recorded highest in I1F3 treatment and

Table 1. Effect of irrigation interval and fertigation strategies on crop growth parameters, yield, CWUE and IWUE of onion.

Treatment	Plant height (cm)		Ind. bulb dia. (cm)		Ind. bulb wt. (g)		Yield (t/ ha)		CWUE (t/ ha-cm)		IWUE (t/ ha-cm)	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Irrigation interval												
I_1	31.2	36.6	4.50	4.99	45.7	54.36	24.90	32.44	0.630	0.830	0.802	0.877
I_2	30.4	35.6	4.5	4.95	44.56	51.59	22.16	31.20	0.561	0.798	0.714	0.843
LSD (P < 5)	0.18	0.97	0.28	0.22	1.79	5.98	3.42	1.52	0.078	0.018	0.111	0.055
Fertigation strategy												
F_1	30.2	35.5	4.37	4.92	43.40	52.30	24.57	31.46	0.622	0.805	0.791	0.850
F_2	30.4	35.7	4.47	4.87	44.88	50.58	23.56	32.20	0.596	0.824	0.759	0.870
F_3	32.4	37.9	4.77	5.28	48.22	59.74	25.02	33.72	0.634	0.863	0.806	0.911
F_4	30.2	35.4	4.52	4.82	44.01	49.29	20.95	29.90	0.531	0.765	0.675	0.808
LSD (P < 5)	0.78	0.95	0.23	0.28	1.69	6.09	2.50	1.68	0.069	0.039	0.079	0.039
Irrigation interval and Fertigation strategy												
I_1F_1	30.1	35.4	4.40	4.97	43.88	53.70	25.70	32.37	0.650	0.828	0.828	0.875
I_1F_2	31.3	36.6	4.33	4.93	44.63	53.15	25.00	32.43	0.633	0.830	0.805	0.877
I_1F_3	32.9	38.6	4.77	5.30	49.08	60.99	26.53	34.50	0.672	0.882	0.854	0.932
I_1F_4	30.6	35.9	4.53	4.77	45.22	49.61	22.36	30.47	0.566	0.779	0.720	0.823
I_2F_1	30.2	35.5	4.33	4.87	42.93	50.89	23.43	30.55	0.593	0.781	0.755	0.826
I_2F_2	29.6	34.7	4.60	4.80	45.13	48.01	22.13	31.97	0.560	0.818	0.713	0.864
I_2F_3	31.9	37.4	4.77	5.27	47.37	58.48	23.52	32.95	0.595	0.843	0.757	0.891
I_2F_4	29.8	34.9	4.50	4.87	42.79	48.97	19.54	29.33	0.495	0.750	0.629	0.793
LSD (P < 5)	1.11	1.34	0.32	0.39	2.39	8.62	3.53	2.38	0.097	0.056	0.113	0.056

there were significant differences between the bulb diameters of I1F1, I1F2 and I2F1 and non-significant differences between the remaining treatments. The individual bulb weight of all the treatments was recorded and the highest bulb weight was I1F3 found. The bulb weights were significantly different in I1F4, I2F1, I2F2 and I2F4 but non-significant for the other treatments.

While comparing the yield under irrigation treatments, highest yield was found in I1 for both the years (24.90 and 32.44 t/ha) (Table 1). But there was non-significant difference between yield of the I1 and I2. The effect of frequent irrigation on the yield was also reported by Mermoud *et al*. (5) and they found the higher yield in frequent irrigation. For the fertigation strategies, highest yield was found in F3 for both the seasons. There was a non-significant difference between F2 and F3 but significant difference was observed between the other fertigation treatments. While comparing the combined effect of irrigation treatment and fertigation strategies, the highest yield was recorded in I1F3 treatment which is significantly higher than the other treatments. From the yield results, it can be concluded that the two day irrigation interval coupled with fertigation during second half of irrigation duration and weekly fertigation performed best for onion crop. These findings are supported by the similar findings reported by Neeraja *et al*. (6); Rajput and Patel (7) and Ajdary *et al*. (1).

The comparison of the CWUE and IWUE under both the irrigation treatments revealed that the highest CWUE and IWUE was found under I1 for both the year (0.630 and 0.830 t/ha-cm; 0.802 and 0.877 t/ha-cm, respectively) with non-significant difference between CWUE and IWUE of the I1 and I2. For the fertigation strategies, highest CWUE and IWUE were found in F3 for both the year (0.634 and 0.863 t/ha-cm; 0.806 and 0.911 t/ha-cm, respectively) with significant difference under F3 and other fertigation treatments. The highest CWUE and IWUE were recorded in I1F3 treatment while comparing the combined effect of irrigation interval and fertigation strategies (0.672 and 0.882 t/ha-cm; 0.854 and 0.932 t/ha-cm, respectively).

From the entire analysis of yield attributes, CWUE and IWUE, it can be concluded that irrigation interval has shown little effect on the onion crop growth parameters and yield of onion crop but fertigation strategy has shown pronounced effect on crop growth parameters and yield of the crop. Two day irrigation interval with fertigation during second half of irrigation duration performed best for onion crop under drip irrigation.

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