

Response of Irrigation and Fertilizer on Growth, Yield and Post Harvest Shelf-Life of Onion

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Abstract

The present investigation was carried out during *rabi* seasons of 2004-06 to study the nutrient and water requirement of onion employing local cultivar Sukhsagar, laid out in split plot design, replicated thrice, with four levels of irrigation (no irrigation, farmers practice i.e. 6—8 days interval, irrigation at 0.55 and 0.80 atmospheric tension) as main plot treatments and three levels of fertilizer (no fertilizer, N:K:S at 100:120:40 kg/ha and N:K:S at 150:180:60 kg/ha) as sub-plot treatments. Observations on plant height (cm), no. of leaves/plant, bolting percentage, neck thickness (cm), diameter of bulb (cm), bulb weight (g), yield (q/ha), TSS, weight loss, rotting and sprouting during storage (%) were recorded. There was significant influence of irrigation on plant height, number of leaves per plant, neck thickness, bulb weight, bulb diameter, bulb yield, weight loss (%), rotting (%) and sprouting (%) of bulb. However, irrigation has no effect on bolting. Irrigation at 0.55 atmospheric tension at 6—8 day intervals was found to be superior to other treatments for growth and yield. The highest yield (199.00 q/ha) was obtained with irrigation at 0.55 atmospheric tension. But, weight loss, rotting and sprouting percentages increased with irrigation at 0.55 atmospheric tension. There was significant influence of fertilizer application on plant height, number of leaves per plant, neck thickness, bolting, bulb weight, bulb diameter, bulb yield, weight loss, rotting and sprouting of onion bulb. A fertilizer dose of N150 kg, K180 kg and S60 kg/ha was superior to other doses of fertilizer. Higher doses of fertilizer increased weight loss, rotting and sprouting percentages. All the characters were found to be negatively correlated with CU in both the years. It depicts that with the increase in consumptive use, there will be definite decrease in plant height, number of leaves, bolting, neck thickness, diameter and weight of bulbs, yield and post harvest attributes too. With an increase in CUE, there has been certain concomitant increase in the yield attributing characters including the post harvest parameters.

Key words : Irrigation, Fertilizer, Onion, Yield, Shelf-life.

Onion (*Allium cepa* L.) is a vegetable, India needs everyday and it is the prime crop among vegetables for trade and export. The national productivity is rather low than other onion producing countries. Interventions through crop management with proper agro-techniques with special emphasis on irrigation regimes and fertilizer scheduling and efficient extension work among the growers are the possible steps to scale up the onion yield. These two input factors, namely irrigation and fertilizer, not only influence growth and yield but also the post harvest shelf-life of onion. Information, specific to this region on these aspects is meager, hence the present study was conducted to assess the response of *rabi* onion to different levels of irrigation and fertilizers along with consumptive use efficiency.

Methods

The experiment was carried out during the *rabi* seasons of 2004—06 at the Horticultural Research Station, Mondouri, in a split plot design replicated thrice. The treatments comprised four irrigation regimes (no irrigation, farmers' practice i.e. 6—8 day interval, irrigation at 0.55 and 0.80 atmospheric tension) in main plot and three levels of fertilizer (no fertilizer, N : K : S at 100 : 120 : 40 kg/ha and N : K : S at 150 : 180 : 60 kg/ha) were allotted as the sub-plot treatments. The soil type of the experimental site was sandy loam with a good water holding capacity and with a pH of 6.7. Five week old seedlings of a local cv Sukhsagar were transplanted during mid December in both the years and were spaced at 15 × 10 cm. The

Table 1. Influence of irrigation and fertilization on growth, yield and post-harvest shelf-life of onion.

Treatment Levels of irrigation	Plant height (cm)	No. of leaves per plant	Neck thickness (cm)	Bolting (%)	Bulb diameter (cm)	Bulb weight (g)	Bulb yield (q/ha)	Sprouting (%)	Weight loss (%)	Rotting (%)
No. irrigation	35.25	6.13	1.12	0.69	4.30	82.89	142.00	19.00	18.25	7.55
Farmers' practice	47.05	7.75	1.43	0.59	4.75	93.50	173.44	23.10	11.27	12.85
0.55 atm tension	48.37	8.50	1.47	0.56	4.97	96.75	179.50	25.00	24.50	12.91
0.80 atm tension	42.47	7.10	1.32	0.67	4.49	91.15	156.85	20.95	19.25	7.75
CD at 5% levels of fertilizer	2.16	0.37	0.05	–	0.38	4.19	6.59	–	–	–
N0 K0 S0	36.72	6.10	1.12	1.40	4.15	82.50	164.00	19.75	17.90	8.25
N100 K120 S40	44.50	7.65	1.40	0.71	5.10	93.70	175.00	25.25	21.32	13.50
N150 K180 S60	48.75	8.80	1.49	0.00	5.25	98.90	199.25	21.90	10.15	15.11
CD at 5%	2.34	0.12	0.04	–	0.30	2.60	6.18	–	–	–

entire quantity of nitrogen was applied in three splits (1/3rd as basal, 1/3rd at 30 DAT and rest at 45 DAT) while full potassic and sulfur fertilizers were applied as basal. One common irrigation was given to all the treatments for better establishment of seedlings. Subsequent irrigations were applied based on schedule and recommended cultural practices were followed. The consumptive use efficiency (kg/ha per mm) was calculated by using the formula $CUE=Y/ET$, where Y =marketable yield (q/ha) and ET =consumptive use (mm). Harvesting was done during mid April each year.

Results and Discussion

Irrigation regimes had significant influence on most of the biometric observations. Table 1 shows that the highest plant height (48.37 cm) and number of leaves (8.50) were recorded at 0.55 atm tension irrigation treatment; farmers' practice was just close behind. The probable reason is the higher available soil moisture regime. Similar observation was obtained by Narang and Dastane (1), who observed that the most suitable regime of soil moisture for onion is when the crop is irrigated at 0.6 bar tension. Though neck thickness of bulb was influenced highly by irrigation application, stress situation would be more desirable in this regard. The effect of irrigation regimes on bolting percentage was found to be negligible. Diameter and bulb weight were influenced markedly by irrigation treatments. The maximum values for these characters were recorded when irrigation was given at 0.55 atmospheric tension. During bulb development moisture stress is undesirable. Higher supply of soil mois-

ture aided both bulb diameter and weight enhancement; this finding is in tune with that of Neeraja et al. (2), who concluded that adequate soil moisture might have enhanced source capacity and sink strength for better performance with regard to bulb weight and polar and equatorial diameters. With regard to bulb yield, the different irrigation schedules recorded higher yield than that unirrigated control. With more plant growth at higher available soil moisture, bigger bulbs were produced. The highest yield was noted with irrigation application at 0.55 atmospheric tension. This finding is supported by the work of Narang and Dastane (1). Other attributes, namely sprouting, rotting and weight loss during post harvest period responded negligibly and showed an inconsistent trend. Bulbs produced with higher soil moisture had a tendency to deteriorate and were found to be less favorable for storage.

Fertilizer application influenced significantly the height of plant and number of leaves per plant. The values for these attributes increased with the rise in the levels of fertilizer over control (no fertilizer) to N150 K180 S60. The present result is supported by the findings of Singh and Batra (3), who reported that an increase in the levels of nitrogen from 50 to 150 kg/ha can significantly increase plant height, number of leaves, size of bulbs and yield. The neck thickness was also more (1.49 cm) in this level of fertilizer application. The higher levels of fertilizer reduced the bolting percentage, which is highly desirable when the crop is grown for bulb. This observation is in agreement with the findings of Singh and Batra (3) and Verma et al. (4). The effect of fertilization on bulb di-

Table 2. Simple correlation between dependent and independent components with respect to CUE and CU during crop growth. *Significant at 5% level. C_1 = CU (1st year), C_2 = CU (2nd year), D_1 = CUE (1st year), D_2 = CUE (2nd year). r_1 = Corresponding value of r of parameters (1st year), r_2 = Corresponding value of r of parameters (2nd year).

Correlation coefficient (r)	Plant height	Leaf no.	Bolting	Neck thickness	Bulb diameter	Bulb weight	Yield	Weight loss	Rotting	Sprouting
C_1r_1	-0.962*	-0.991*	-0.940*	-0.985*	-0.981*	-0.978*	-0.986*	-0.993*	-0.997*	-0.997*
C_1r_2	-0.962*	-0.993*	-0.866*	-0.988*	-0.980*	-0.985*	-0.988*	-0.994*	-0.994*	-0.996*
C_2r_1	-0.959*	-0.992*	-0.935*	-0.979*	-0.982*	-0.976*	-0.979*	-0.994*	-0.994*	-0.996*
C_2r_2	-0.960*	-0.993*	-0.899*	-0.980*	-0.982*	-0.979*	-0.980*	-0.991*	-0.991*	-0.998*
D_1r_1	0.998*	0.986*	0.995*	0.998*	0.997*	0.998*	0.992*	0.994*	0.975*	0.979*
D_1r_2	0.999*	0.987*	0.970*	0.997*	0.996*	0.999*	0.991*	0.995*	0.976*	0.980*
D_2r_1	0.998*	0.998*	0.985*	0.998*	0.995*	0.996*	0.992*	0.980*	0.980*	0.985*
D_2r_2	0.997*	0.985*	0.975*	0.997*	0.975*	0.997*	0.991*	0.995*	0.995*	0.980*

ameter and weight was found to be highly significant. Table 1 revealed that higher levels of fertilizer produced bigger sized bulbs with more weight. Consequently, the bulb yield was markedly influenced with the application of fertilizer. The highest yield was obtained from the treatment where 150 kg of nitrogen, 180 kg of potassium and 60 kg of sulfur per hectare were applied. Almost similar result was reported by Pandey (5). In relation to post-harvest shelf-life of the crop, different attributes were influenced by fertilizer application though not in a systematic manner. In sprouting and rotting of bulb, higher levels of fertilizer recorded slightly lower values. The possible reason is that higher doses of potash and sulfur might have reduced the sprouting and rotting percentage of onion bulbs by checking the adverse effect of higher dose of nitrogen. In both the years, response of different yield attributing components and yield to various levels of fertilizer depended greatly on the available soil moisture. Significant increase in all the yield attributing components and yield itself was obtained with N150 K180 S60/ha at 0.55 atmospheric tension, which proves that effectiveness of applied nutrients increased with more supply of moisture. Table 2 shows that different yield attributing characters like plant height, number of leaves, bulb diameter etc. and other post harvest shelf-life related attributes, namely weight loss, rotting and sprouting of bulbs are correlated with consumptive use (CU) and consumptive use efficiency (CUE) of the crop. All the characters are negatively correlated with CU in both the years. It

depicts that with the increase in consumptive use, there will be definite decrease in plant height, number of leaves, bolting, neck thickness, diameter of bulb, weight of bulb and yield. Lower water loss, rotting and sprouting percentages were noted with increased CU; all of these characters, however, were positively correlated to CUE in both the years. Thus the result indicates that with an increase in CUE, there will be certain concomitant increase in the yield attributing characters including the post harvest parameters. All available evidences indicate that under adequate irrigation and fertilization regimes yield of onion increases considerably with relatively small increase in consumptive use and marked improvement in consumptive water use efficiency.

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