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DECIDING WITHDRAWAL OF IRRIGATION AND ITS EFFECT ON STORABILITY UNDER DIFFERENT IRRIGATION METHODS FOR ONION

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Abstract:

The present investigation "Deciding withdrawal of irrigation and its effect on storability under different irrigation methods for onion" was conducted at research farm of Interfaculty Department of Irrigation Water Management, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri during January to May, 2018. The experiment was carried out in Factorial Randomized Block Design (FRBD) involving 9 treatments with 4 replications. The treatments comprised of combinations of three irrigation methods *viz.* surface irrigation, micro sprinkler irrigation and drip irrigation and three withdrawal timing of irrigation *viz.* 2 weeks, 3 weeks and 4 weeks before harvesting.

The soil of the experimental field was sandy clay loam in texture, moderately alkaline in reaction with available nitrogen (173.50 kg ha^{-1}), phosphorus (16.70 kg ha^{-1}) and potassium (333 kg ha^{-1}). The electrical conductivity and pH were 0.32 dSm^{-1} and 7.6 respectively. The yield parameters and yield were significantly influenced by irrigation method and withdrawal of irrigation. The drip irrigation produced higher bulb yield which was significantly superior over surface irrigation but non-significant over micro-sprinkler irrigation. The storage losses were higher in micro sprinkler irrigation (47.94 %) followed by surface irrigation (36.87 %) and lowest in drip irrigation (31.25 %). Among the withdrawal of irrigation, storage losses were higher in withdrawal of irrigation 2 weeks before harvesting (40.77 %) followed by withdrawal of irrigation 3 weeks (38.62 %) and 4 weeks (36.67 %) before harvesting.

The higher net monetary returns from onion crop (181600 $Rs.ha^{-1}$) were obtained in drip irrigation followed by micro sprinkler irrigation (173940 $Rs.ha^{-1}$). The net monetary return in 3 weeks before withdrawal of irrigation was higher (182042 Rs. ha^{-1}) followed by 2 weeks before harvesting (172799 Rs. ha^{-1}). The higher B:C ratio of (2.63) was obtained in surface irrigation. Among withdrawal of irrigation higher B: C ratio of (2.58) was obtained in withdrawal of

irrigation 3 weeks before harvesting. The study revealed that onion crop irrigated with drip irrigation and coupled with withdrawal of irrigation 3 weeks before harvesting is suitable in terms of yield, storage losses and economic returns.
Keywords: Methods of irrigation, Withdrawal of irrigation, Yield, Storage losses, Economic, Onion,

Introduction:

Onion (*Allium cepa* L.) is most important vegetable crop of world. It belongs to the Alliaceae family and has its origin in Central Asia. It is valued for its distinctive pungent flavor and is an essential ingredient of the cuisine in all regions of the country. In India, total area under cultivation of onion is 1.29 m ha and the production is about 21.71 MT. The average productivity of onion in India is 16.8 t ha^{-1}(Anonymous, 2017). Maharashtra is the major onion producing state with 30.41 % of the production share followed by the Karnataka, Madhya Pradesh, Rajasthan and Gujarat with 15.51%, 13.66%, 6.49%, and 6.31% respectively. The production of onion in Maharashtra is 6.77 MT on area 0.471 m ha with productivity on 14.37 tha^{-1}(Anonymous, 2017).

In India, average productivity of onion is low as compared to world's productivity. There are several reasons of low productivity *viz* variety, season, soil, irrigation method etc. Out of them irrigation method plays a vital role(Patel and Rajput, 2009). In India, farmers usually adopt conventional method of irrigation which usually associated with large irrigation depth and low water productivity. On other side, onion crop is very sensitive to irrigation quantity lesser or higher, since it has a shallow, sparsely branched root system with maximum roots in the top 30 cm of soil (Jongtae *et al.* 2011). It requires frequent irrigation compared to other vegetable crop. Hence, providing appropriate quantity of irrigation at proper time plays a vital role in enhancing productivity of onion.

Being a semi-perishable crop, onion is subjected to deterioration during storage. Storage loss of onions is caused by rotting, sprouting and physiological weight loss. Nevertheless, many factors such as cultivars, bulb maturity, soil moisture content, temperature, relative humidity etc. are associated with the spoilage of onion during storage. Out of this soil moisture content at harvest may be an important factor which mainly decided by irrigation method. This moisture content directly depends on type of irrigation method and withdrawal of irrigation before harvesting. Soujala *et al*. (1998) reported that irrigation had only a minor effect on the storage performance and shelf life of onion. While substantial increase of decomposition in onion during storage with increasing irrigation was reported by Shock *et al*. (1998). Differently, Nandi *et al*. (2002) reported that growth and yield of onion were significantly affected by irrigation, but not post harvest life. Bhagyawant (2016)also reported irrigation method plays an important role on storability of onion as it depends upon soil moisture content. Thus, it was attempted to effect of withdrawal timing of irrigation on these aspects.

Materials and Methods

The present investigation entitled "Deciding withdrawal of irrigation and its effect on storability under different methods for onion" was carried out at the Experimental Cum Demonstration Farm of Interfaculty Department of Irrigation Water Management, Mahatma Phule Krishi Vidyapeeth, Rahuri during *Rabi* season of the year 2018-19. The experimental plot was uniform and leveled with well drained, medium black clay soil, alkaline in nature with pH as 7.9. The soil texture was Sandy clay loam with 21.48% coarse sand, 34.84% silt and 26 % clay with medium depth. The bulk density of soil was 1.30 g/cm^3 and electrical conductivity was 0.32 dSm^{-1}.The soil contain available N (173.50 kg/ha), and P (16.7 kg/ha) and available K (333 kg/ha) content. The soil was having moisture contents at field capacity, permanent wilting point and available soil moisture as 34.80, 15.50 and 19.30%, respectively. The experiment was laid out in Factorial Randomized Block Design (FRBD) with four replications and nine treatments. Irrigation MethodsI1 – Surface irrigation; I2– Micro

sprinkler irrigation; I3 – Drip irrigation; and Withdrawal of Irrigation W1- 2 weeks before harvesting; W2- 3 weeks before harvesting; W3- 4 weeks before harvesting; Treatment details are

T1- Surface irrigation + withdrawal of irrigation 2 weeks before harvesting ;T2- Surface irrigation+ withdrawal of irrigation 3 weeks before harvesting; T3- Surface irrigation + withdrawal of irrigation 4 weeks before harvesting; T4- Micro sprinkler irrigation + withdrawal of irrigation 2 weeks before harvesting; T5- Micro sprinkler irrigation + withdrawal of irrigation 3 weeks before harvesting;

T6- Micro sprinkler irrigation + withdrawal of irrigation 4 weeks before harvesting; T7 -Drip irrigation + withdrawal of irrigation 2 weeks before harvesting ;T8- Drip irrigation + withdrawal of irrigation 3 weeks before harvesting; T9 -Drip irrigation + withdrawal of irrigation 4 weeks before harvesting; Surface irrigation applied 50 mm water at 50 mm CPE: Drip irrigation applied alternate day based on crop evapo-transpiration and Micro sprinkler irrigation applied twice in a week based on crop evapo-transpiration.

The volume of water to be applied for growing period through drip and micro sprinkler was worked out with the following formula.

V = ETc x Plot area

Where,

V = Volume of water (lit)

Etc= Evapo-transpiration

Plot area = 32.4 m^2

Similarly, Economics of experiment such as total cost of cultivation, total income from produce, total net income and other relevant parameters were estimated.

Results and Discussion:

Yield

The treatment that had withdrawal of irrigation 3 weeks before harvesting registered significantly superior bulb yield (36.14 t ha^{-1}) over the treatment that have withdrawal of irrigation 4 weeks before harvesting (32.18 t ha^{-1}). However, it was at par with the treatment that had withdrawal of irrigation 2 weeks before harvesting (35.28 t ha^{-1}). The W2 withdrawal timing received adequate time for translocation process and hence gave higher bulb yield (36.14 t ha^{-1}).

Storage losses

The total loss in weight was affected by different irrigation methods. The higher weight loss was observed in micro sprinkler irrigation (47.94%) followed by surface irrigation (36.87 %). The lowest total loss in weight was observed in drip irrigation (31.25 %). Tripathi *et al.* (2010), also reported that the total storage losses after three months of storage were lowest in drip irrigation (13.38 %) followed by surface irrigation (13.59 %). While higher losses were found in micro sprinkler irrigation (22.58 %) and overhead sprinkler irrigation (32.25%). The storage losses of onion were found increased gradually with increase in number of irrigations. The total loss in weight was higher in withdrawal of irrigation 2 weeks before harvesting (40.77 %) as compared to both of withdrawal of irrigation 3 weeks and 4 weeks before harvesting. The more storage losses in micro sprinkler irrigation method was may be due to the fact that the over canopy irrigation allows the disease-causing microorganism in later stage of bulb maturity. The over canopy irrigation also attributed to entry of water in the neck of onion at bulb during maturity.

Economics

The data regarding the cost of cultivation, gross and net returns and benefit: cost ratio for cultivation of onion seeds are presented in Table 2. The cost of cultivation of onion bulb per hectare was estimated and inferences were drawn on the basis of the mean value. The cost

of cultivation was determined by adding fixed cost of irrigation system and operation cost of cultivation for respective

Table no. 1) Data of influence of different irrigation methods and withdrawal of irrigation on Onion

SR. No	Treatment	Yield (t/ha)	Average bulb Weight (gm)	Polar diameter (cm)	Equatorial diameter (cm)	Rotted Bulbs (%)	Sprouted Bulbs (%)	Total loss (%)	Irrigation water Applied (cm)
A	**Irrigation methods**								
I_1	Surface Irrigation	30.87	90.62	4.30	5.82	24.10	0.34	36.87	666.66
I_2	Micro sprinkler irrigation	35.50	115.20	4.61	6.44	30.43	6.59	47.94	347.94
I_3	Drip irrigation	37.24	115.52	4.63	6.63	16.24	2.57	31.25	358.04
	S.E.±	0.80	6.4	0.08	0.15				
	CD at 5%	2.41	19.3	0.26	0.46				
B	**Withdrawal of irrigation**								
W_1	2 weeks before harvesting	35.28	110.36	4.61	6.38	25.39	5.28	40.77	513.53
W_2	3 weeks before harvesting	36.14	118.64	4.65	6.55	23.29	2.77	38.62	452.52
W_3	4 weeks before harvesting	32.18	92.33	4.29	5.96	22.08	1.44	36.67	406.6
	S.E.±	0.80	6.418	0.08	0.15				
	CD at 5%	2.41	19.34	0.26	0.46				
C	**Interaction**								
	S.E.±	1.38	11.11	0.15	0.26				
	CD at 5%	4.18	NS	NS	NS				
	General mean	34.53	107.11	4.51	6.30				

treatments. The fixed 55 cost was high in both micro irrigation methods due to initial system cost. Differently, operational cost was high in surface irrigation system (58107 Rs.ha^{-1}) as compared to the drip (54206 Rs.ha$^{-1)}$ and micro sprinkler irrigation system (54198 Rs.ha^{-1}). This was due to the more labour charges and water charges involved in surface irrigation system. As a result of more fixed cost, the cost of cultivation was more in drip irrigation system (79045 Rs.ha^{-1}) followed by the micro sprinkler irrigation system (74572 Rs.ha^{-1}). It was lowest in surface irrigation system (59587 Rs.ha^{-1}). The total cost of cultivation in drip irrigation was considerably higher as compared with micro sprinkler irrigation method mainly due to variation in number of laterals, drippers used and lateral length on hectare basis.

The gross monetary returns also influenced significantly under different withdrawal timing of irrigation. Higher gross monetary returns (252998 Rs. ha^{-1}) was observed in withdrawal of irrigation 3 weeks before harvesting followed by withdrawal of irrigation 2 weeks before harvesting (246948 Rs. ha^{-1}). The lowest gross monetary returns obtained in withdrawal of irrigation 4 weeks before harvesting (225272 Rs.ha^{-1}). Similar to cost of cultivation and gross monetary returns, the B: C ratio also influenced under different withdrawals of irrigation. Higher B:C ratio was observed in the treatments which had withdrawal of irrigation 3 weeks before harvesting (2.58) followed by 2 weeks before harvesting (2.45). The lowest B:C ratio obtained in the treatments of irrigation withdrawal 4 weeks before harvesting (2.23).

Conclusion

Looking to the results of the study on "Deciding withdrawal of irrigation and its effect on storability under different irrigation methods for onion" the following conclusions were drawn:

1. Minimum storage losses observed in drip irrigation and maximum storage losses observed in micro sprinkler irrigation. Among withdrawal of irrigation maximum storage losses observed in withdrawal of irrigation 2 weeks before harvesting and minimum storage losses observed in withdrawal of irrigation 4 weeks before harvesting.
2. The highest B:C ratio was obtained in surface irrigation (2.63). In case of withdrawal of irrigation, the highest B:C ratio was obtained in withdrawal of irrigation 3 weeks before harvesting (2.58).

On the basis of the results obtained that under limited water condition application of drip irrigation up to 3 weeks before harvesting is the best practice to obtain better yield, water and minimum storage losses from *Rabi* onion (*Cv*. N-2-4-1) cultivation.

Fig. 1 Percentage of rotted bulbs, sprouted bulbs and Total loss of onion under different irrigation methods and withdrawal of irrigation

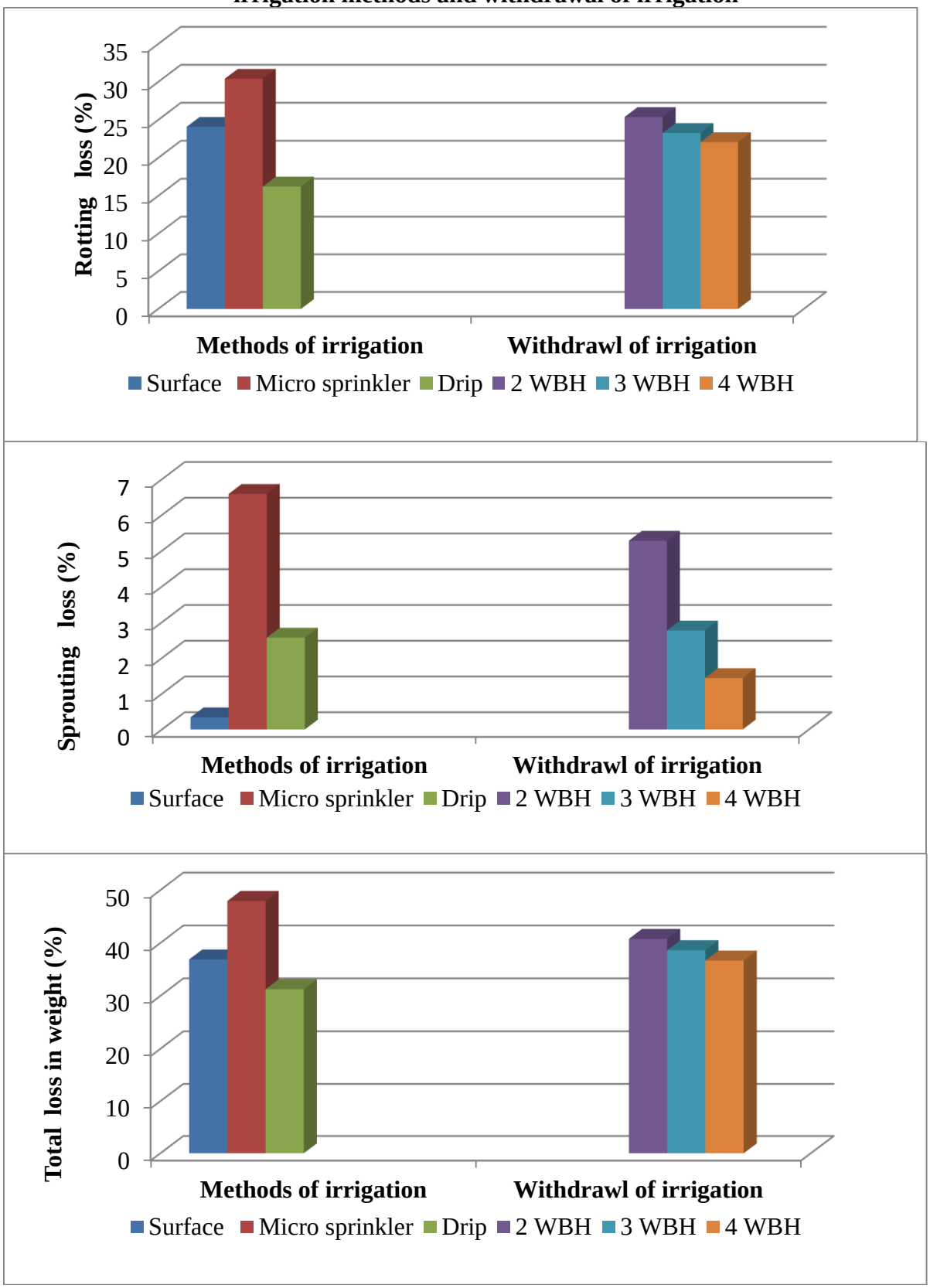

Table 2) Economic studies onion under different irrigation methods and withdrawal of irrigation

Sr. No.	Treatment	Total cost of cultivation (Rs. ha^{-1})	Gross monetary returns (Rs. ha^{-1})	Net monetary returns (Rs. ha^{-1})	B: C ratio
A. Irrigation methods					
I1	Surface irrigation	59587	216061	156473	2.63
I2	Micro sprinkler irrigation	74572	248512	173940	2.33
I3	Drip irrigation	79045	260645	181600	2.30
B. Withdrawal of irrigation					
W1	2weeks before harvesting	71652	246948	175296	2.45
W2	3weeks before harvesting	70956	252998	182042	2.58
W3	4weeks before harvesting	70596	225272	154676	2.23

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