Journal of Applied Horticulture, 24(1): 116-120, 2022

DOI: https://doi.org/10.37855/jah.2022.v24i01.22

Journal of Applied Horticulture

ISSN: 0972-1045

Effect of regulated deficit irrigation and partial root zone drying regimes on shelf life of mango (*Mangifera indica* L.) cultivar Dashehari

K. Simrandeep*, S. Arti, S. Abhijit, J. Amit, B. Deep ji and J. Mahital

*Division of Fruit Science, Faculty of Agriculture, Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu, Chatha, Jammu- 180009, India. *E-mail*: *simrandeep.kour88@gmail.com*

Abstract

A two-year study was undertaken in the Division of Fruit Science, SKUAST-J, to examine the effect of differential irrigation regimes as pre-harvest treatments (regulated deficit irrigation and partial root-zone drying) on the shelf life of mango grown in open field conditions. Maximum physiological weight loss (21.06 and 21.10%) and decay loss (51.00% and 52.20%) was recorded under treatment T_{10} (No irrigation) whereas, minimum was recorded in treatment T_9. The fruit moisture was recorded maximum in T_7 (77.46 % and 77.72 %) whereas T_{10} recorded minimum fruit moisture (70.55 and 70.83%) during both the year 2017 and 2018, respectively. Both years recorded maximum fruit firmness in T_9 (21.62 and 22.47 lb/in^2) and minimum in T_{10} (14.61 and 15.46 lb/in^2). On a mean value basis maximum fruit moisture content and fruit firmness was recorded on 0 day of storage which decreased significantly and continuously upto 10th the day of storage. In contrast, minimum PLW content was recorded on 2nd day of storage which increased significantly and continuously up to 10th the day of storage and minimum decay loss content was recorded on 6th day of storage which increased significantly and continuously upto 10th the day of storage during 2017 and 2018, respectively.

Key words: Regulated deficit irrigation, partial root zone drying, storage, fertigation.

Introduction

Mango (*Mangifera indica* L.) is the most popular and the choicest fruit produced in the tropical and sub-tropical regions of the world. India is the world's largest producer of mango, contributing about 50% of total production worldwide (Barman *et al.* 2015). In Jammu and Kashmir mango is grown in sub-tropical areas of Jammu, Samba, Kathua, Udhampur, Reasi and Rajouri districts of Jammu province. The current area and production of mango in India is 2288 thousand hectares and production 21253 thousand million tonnes (Anonymous, 2018) whereas, in Jammu province of J&K union territory, the total area under mango cultivation is 13037 ha with the total production of 30478 metric tonnes, respectively (Anonymous, 2019).

Availability of irrigation water is the major constraint to crop production in many parts of the world. With the drip irrigation systems, water and nutrients can be applied directly to the crop at the root level, positively affecting yield and water savings (Nagaz *et al.*, 2012). The advantage of deficit irrigation is a significant technological improvement in irrigation system, which helps to combat water scarcity in agriculture. In recent years, regulated deficit irrigation (RDI) was developed to minimize irrigation inputs for fruit production in areas where water is a limiting resource. It consists of withholding water during certain periods to produce moderate drought stress and to obtain beneficial consequences on fruit quality while limiting shoot growth. Results of RDI experiments have been promising in certain regions and for some fruit crops, such as peach (*Prunus persica* L.).

Partial root-zone drying (PRD) is an innovative irrigation technique that is thought to reduce plant's water consumption based on the induction of changes in the plants' hormonal balance and chemical signaling of roots in the drying soil (Davies *et al.*, 2000, 2002; Lo Bianco *et al.*, 2007). To stimulate these responses, under PRD, one side of the root system is well watered while the other falls dry. In the drying part of the roots, increased amounts of abscisic acid (ABA) are produced, which make the plant reduce its water consumption however, through the wet side of the root system, it is still wet enough supplied to maintain fruit growth, while vegetative growth is reduced (Dry *et al.*, 2000).

Fertigation enables adequate supplies of water and nutrients with precise timing and uniform distribution to meet the crop nutrient demand. Sharma *et al.* (2017) studied the effect of irrigation intervals and calcium sprays on the shelf life of litchi (*Litchi chinensis* Sonn.) cv. Dehradun and suggested that if litchi was sprayed with 2% $CaCl_2$ better shelf life can be obtained even with less irrigation without affecting quality thereby optimising the use of precious input *i.e.* water which is getting scarce day by day. Further, fertigation ensures substantial fertilizer usage savings and reduces leaching losses (Kumar *et al.,* 2007).

Mango is a climacteric fruit, often harvested at the mature, hard green pre-climacteric stage and it undergoes numerous biochemical changes during ripening within 9-12 days at ambient temperature. The short ripening period and low-temperature sensitivity limit its potential for a distant market. Ripening of fruits is triggered by ethylene, whether derived from endogenous or exogenous sources (Wills *et al.,* 1998). Various pre-harvest treatments affect the quality and shelf life of fruits. Irrigation is the major pre-harvest factor directly affecting post-harvest quality and shelf life. The impact of water deficit on fruit quality has been investigated for several fruit species. Total soluble solids in peach fruit increased under a high water restriction as compared to control and light water restriction (Mercier *et al.*, 2009). Garcia-Tejero (2010) determined the postharvest fruit quality of oranges (*Citrus sinensis* L. Osbeck, cv. Salustiano) exposed to RDI in commercial orchards. Pickering *et al.* (2002) found a positive influence of water deficit on mango fruit quality. Any production technology to increase production has to be tested for its effect on quality and storage life. The present study's aim was to determine whether different deficit irrigation regimes *viz*. PRD and RDI along with fertigation affect the shelf life of mango.

Material and methods

The present study was conducted in the Division of Fruit Science, SKUAST-J, Chatha Jammu to study the effect of different irrigation regimes on shelf life of mango during the year 2017-18 and 2018-19 on 12 year old mango trees of cv. Dashehari having uniform vigour and size. The experiment was laid out in Randomized Block Design with ten irrigation treatments and three replications. The fruits were harvested from the trees under following treatments:

T_1 100% ETc
T_2 RDI 75% ETc evenly applied under the canopy
T_3 PRD 75% ETc applied to alternating sides of the root system
T_4 RDI 50% ETc evenly applied under the canopy
T_5 PRD 50% ETc applied to alternating sides of the root system
T_6 RDI 75% ETc evenly applied under the canopy + Fertigation with K_2SO_4 (0.5%), H_3BO_3(0.5%) and $Ca(NO_3)_2$(1%)
T_7 PRD 75% ETc applied to alternating sides of the root system + fertigation with K_2SO_4 (0.5%), H_3BO_3 (0.5%) and $Ca(NO_3)_2$(1%)
T_8 RDI 50% ETc evenly applied under the canopy + fertigation with K_2SO_4 (0.5%), H_3BO_3 (0.5%) and $Ca(NO_3)_2$ (1%)
T_9 PRD 50% ETc applied to alternating sides of the root system + fertigation with K_2SO_4 (0.5%), H_3BO_3 (0.5%) and $Ca(NO_3)_2$ (1%)
T_{10} No Irrigation

ETc- Crop evapotranspiration, F- Fertigation, RDI- Regulated deficit irrigation, PRD- Partial root zone drying

For shelf life studies fruits, after harvest were stored at room temperature in baskets and parameters were recorded on 0, 2nd, 4th, 6th, 8th and 10th days of storage. The moisture content was determined by using an electronic moisture analyser at 105 ^{0}C by spreading a weighed sample (2 g) in an aluminum sample holder, and evaporative moisture losses were automatically expressed as percent moisture content. Pre-weighed fruit samples were weighed on a physical balance after each storage interval. The loss in weight at each interval during storage was expressed as percent of initial weight. Fruit firmness of the fruit was recorded with the help of penetrometer. The decay percentage of mango fruits was calculated as the number of decayed fruit divided by the initial number of fruits and multiplied by a hundred.

Data analysis: Data were analyzed statistically as per the method of Panse and Sukhtame (2000).

Results and discussion

Moisture content: Table 1 on fruit moisture content in mango fruits under different treatments reveals that fruit moisture decreased with storage. On mean value basis, maximum percent fruit moisture content (77.46 %) was recorded in T_7 (PRD 75 % ETc + F) whereas, the minimum percent fruit moisture content (70.55 %) was recorded in T_{10} (no irrigation) throughout the storage period. Maximum percent fruit moisture content (76.73 %) was recorded on 0 day of storage which decreased significantly and continuously upto 10th the day of storage (72.20 %). However, interaction between treatments and storage was observed to be non significant. During second year of investigation (2018), percent of fruit moisture was higher as compared to year 2017. On mean value basis in 2018, maximum percent fruit moisture content (77.72 %) was recorded in T_7 (PRD 75 % ETc + F) whereas, minimum fruit moisture content (70.83 %) was recorded in T_{10} (no irrigation) throughout the storage period. Maximum percent fruit moisture content was recorded on 0 day of storage (77.08 %) which decreased significantly and continuously upto 10th the day of storage (72.48 %). The reduction in moisture content may be due to transpiration losses and to some extent to fruit respiration as reported by Rathore *et al.* (2007). The present results are in agreement of the findings of Proietti and Antognozzi (1996) who reported that with an increasing irrigation regime, the pulp water content of olive was increased.

Physiological weight loss: Data on the physiological loss in

Table 1. Effect of different irrigation regimes and fertigation on fruit moisture (%) of mango cv. Dashehari during storage in the year 2017 and 2018

Treatments		Storage (Number of days)													
		2017							2018						
		0	2	4	6	8	10	Mean	0	2	4	6	8	10	Mean
T_1	100% ETc	74.86	74.27	73.07	71.87	71.08	70.05	72.53	75.22	74.62	73.29	72.18	71.32	70.25	72.81
T_2	RDI 75% ETc	76.07	75.18	74.42	73.24	72.17	71.47	73.75	76.31	75.53	74.84	73.61	72.48	71.72	74.06
T_3	PRD 75% ETc	77.25	76.36	75.04	74.08	72.88	72.45	74.67	77.64	76.72	75.26	74.30	73.21	72.85	74.99
T_4	RDI 50% ETc	75.04	74.56	73.19	72.19	71.24	70.16	72.73	75.45	74.89	73.51	72.46	71.61	70.48	73.06
T_5	PRD 50% ETc	75.80	75.04	74.13	73.06	72.07	71.26	73.56	76.19	75.36	74.40	73.29	72.33	71.53	73.87
T_6	RDI 75% ETc + F	79.43	78.34	77.05	76.65	75.32	75.01	76.96	79.86	78.66	77.48	76.93	75.66	75.23	77.30
T_7	PRD75% ETc + F	79.76	78.09	77.87	76.98	76.18	75.89	77.46	80.03	78.32	78.11	77.21	76.54	76.11	77.72
T_8	RDI 50% ETc + F	78.14	76.89	75.74	75.27	74.11	73.77	75.65	78.42	77.11	76.03	75.62	74.31	74.08	75.92
T_9	PRD 50% ETc +F	78.22	77.04	76.17	75.46	74.22	73.85	75.82	78.63	77.23	76.52	75.85	74.42	74.13	76.13
T_{10}	No Irrigation	72.76	72.18	71.06	69.89	69.24	68.18	70.55	73.09	72.42	71.28	70.16	69.57	68.46	70.83
Mean		76.73	75.79	74.77	73.86	72.85	72.20		77.08	76.08	75.07	74.16	73.14	72.48	
CD 0.05 (A)								1.320							1.278
CD 0.05 (B)								1.022							0.990
CD 0.05 (AxB)								N.S.							N.S.

weight under various treatments for the two consecutive years (2017 and 2018) are given in Table 2. First year of investigation revealed that with the advancement of storage period, percent physiological loss in weight of mango increased significantly. On mean value basis maximum PLW of 21.06 % and 21.10 % during 2017 and 2018, respectively, was recorded in T_{10} (no irrigation) whereas, minimum PLW (12.81 per cent and 12.85 per cent) during 2017-18 and 2018-19, respectively, was recorded in T_9 (PRD 50% ETc + F) throughout the storage period. On mean value basis minimum PLW content was recorded on 2nd day of storage (7.71 % and 7.74 %) during 2017 and 2018, respectively which increased significantly and continuously up to 10th the day of storage (23.20 % and 23.24 %) during 2017 and 2018, respectively. However, interaction between treatments and storage was observed to be non significant. Physiological loss in weight was higher in the year 2018 as compared to year 2017 irrespective of treatments and showed similar increase with increase in storage period as in 2017. Increase in fruit weight loss with increasing number of days may be due to respiration and transpiration of water through fruit peel tissue and to some biological changes occurring in fruits (Rathore *et al.,* 2007). Mahajan and Sharma (2000) stated that reduction in weight loss in peach fruits as a result of calcium application may possibly be due to the action of $CaCl_2$ in lowering the respiration rate and protecting the cell membrane from disintegration thereby leading to delay in senescence. These findings substantiate the earlier reports on the aspects by Bhat *et al.* (2014) in peaches; Gupta and Mehta (1988) in ber; Singh and Chauhan (1993) in guava and Sharma *et al.* (2017) in litchi.

Fruit firmness: Data presented in Table 3 illustrates the effect of deficit irrigation and fertigation on fruit firmness in mango cv. Dashehari. A perusal of data during the first year of investigation revealed that with advancement of storage life, the fruit firmness decreased. On mean value basis maximum fruit firmness (27.33 lb/in^2 and 28.12 lb/in^2) during 2017 and 2018, respectively was recorded in T_9 (PRD 50% ETc + F) whereas, minimum fruit firmness (20.97 lb/in^2 and 21.62 lb/in^2 during 2017-18 and 2018-19, respectively) was recorded in T_{10} (no irrigation) throughout the storage period. On mean value basis maximum fruit firmness was recorded on 0 day of storage (24.56 lb/in^2 and 25.15 lb/in^2) during 2017 and 2018, respectively, which decreased significantly and continuously up to 10th the day of storage (10.80 lb/in^2 and 11.20 lb/in^2) during 2017 and 2018, respectively, irrespective of treatment. However, interaction between treatments and storage was observed to be non significant. Fruit firmness was higher in the year 2018 as compared to year 2017 irrespective of treatments and showed similar decrease with increase in storage period as in 2017.

Fruit firmness is an important quality in fruit production that can decide when fruit will be harvested, transported, stored, or marketed. The results of this study showed an increase in fruit firmness with reduction in water application. The firmness of fruits and vegetables is mainly influenced by their moisture

Table 2. Effect of different irrigation regimes and fertigation on physiological loss in weight (%) of mango cv. Dashehari during storage

Treatments		Storage (Number of days)													
		2017							2018						
		2	4	6	8	10	12	Mean	2	4	6	8	10	12	Mean
T_1	100% ETc	8.98	12.06	15.05	18.02	21.07	24.01	16.53	9.02	12.10	15.09	18.06	21.11	24.05	16.57
T_2	RDI 75% ETc	8.60	11.74	14.57	17.79	20.78	23.65	16.18	8.64	11.78	14.61	17.83	20.82	23.69	16.22
T_3	PRD 75% ETc	8.52	11.57	14.45	17.28	20.44	23.52	15.96	8.56	11.61	14.49	17.32	20.48	23.56	16.00
T_4	RDI 50% ETc	7.27	10.41	13.24	16.59	19.73	22.27	14.91	7.23	10.45	13.28	16.63	19.77	22.31	14.94
T_5	PRD 50% ETc	7.03	10.25	13.11	16.42	19.28	22.21	14.71	7.07	10.29	13.15	16.46	19.32	22.25	14.75
T_6	RDI 75% ETc + F	6.85	9.88	12.92	15.79	18.85	21.75	14.34	6.89	9.92	12.96	15.83	18.89	20.63	14.38
T_7	PRD 75% ETc + F	6.61	9.59	12.77	15.52	18.48	21.48	14.07	6.65	9.63	12.81	15.56	18.52	21.52	14.11
T_8	RDI 50% ETc + F	5.36	8.24	11.65	14.68	17.65	20.79	13.06	5.40	8.28	11.69	14.72	17.69	21.79	13.10
T_9	PRD 50% ETc +F	5.24	8.15	11.29	14.19	17.41	20.59	12.81	5.28	8.19	11.32	14.23	17.45	20.83	12.85
T_{10}	No Irrigation	12.68	15.25	18.39	21.78	26.49	31.78	21.06	12.73	15.29	18.43	21.82	26.54	31.82	21.10
Mean		7.71	10.71	13.74	16.80	20.01	23.20		7.74	10.75	13.78	16.84	20.05	23.24	
CD 0.05 (A)								1.32							0.65
CD 0.05 (B)								1.02							0.50
CD 0.05 (AxB)								N.S							N.S.

Table 3. Effect of different irrigation regimes and fertigation on fruit firmness (Lb/inch^2) of mango cv. Dashehari during storage

Treatments		Storage (Number of days)													
		2017							2018						
		0	2	4	6	8	10	Mean	0	2	4	6	8	10	Mean
T_1	100% ETc	22.54	21.33	17.75	15.82	9.59	7.48	15.75	23.42	22.57	18.64	16.86	9.68	7.91	16.51
T_2	RDI 75% ETc	23.35	22.42	18.37	16.34	10.14	8.71	16.55	24.21	23.26	19.25	17.37	11.24	9.52	17.47
T_3	PRD 75% ETc	23.88	22.78	18.86	16.97	10.72	9.54	17.12	24.67	23.54	19.66	17.75	11.63	10.47	17.95
T_4	RDI 50% ETc	24.22	22.14	19.69	17.25	11.65	10.88	17.63	25.31	24.42	20.82	18.24	11.89	11.47	18.69
T_5	PRD 50% ETc	24.71	23.65	20.26	17.89	12.84	11.69	18.50	25.63	24.78	21.47	18.68	13.63	11.88	19.34
T_6	RDI 75% ETc + F	25.62	24.84	20.81	18.74	13.78	12.05	19.30	26.83	25.71	21.74	19.66	14.66	12.52	20.18
T_7	PRD 75% ETc + F	26.14	25.23	21.74	19.68	14.52	12.67	19.99	27.56	26.59	22.71	20.55	15.33	12.86	20.93
T_8	RDI 50% ETc + F	26.85	25.66	22.29	20.18	15.71	13.74	20.73	27.79	26.86	23.78	21.24	16.65	14.19	21.75
T_9	PRD 50% ETc +F	27.33	26.56	23.65	20.77	16.64	14.78	21.62	28.12	27.74	24.52	21.67	17.73	15.08	22.47
T_{10}	No Irrigation	20.97	19.71	16.76	15.09	8.63	6.52	14.61	21.62	20.72	17.66	16.17	9.47	7.14	15.46
Mean		24.56	23.43	20.01	17.87	12.42	10.80		25.51	24.61	21.02	18.81	13.19	11.20	
CD 0.05 (A)								0.56							0.78
CD 0.05 (B)								0.43							0.41
CD 0.05 (AxB)								N.S.							N.S.

Table 4. Effect of different irrigation regimes and fertigation on decay loss (%) of mango cv. Dashehari during storage in the year 2017 and 2018

Treatments		Storage (Number of days)							
		2017				2018			
		6	8	10	Mean	6	8	10	Mean
T_1	100% ETc	14.00	49.00	84.00	49.00	15.00	50.00	85.00	50 .00
T_2	RDI 75% ETc	9.00	44.00	74.00	42.33	10.00	45.00	75.00	44 .00
T_3	PRD 75% ETc	9.00	44.00	74.00	42.33	10.00	45.00	75.00	43.33
T_4	RDI 50% ETc	9.00	39.00	64.00	37.33	10.00	40.33	65.00	38.33
T_5	PRD 50% ETc	9.00	39.00	64.00	37.33	10.00	40.33	65.00	38.33
T_6	RDI 75% ETc + F	4.00	34.00	74.00	37.33	5.00	35.00	75.00	38.33
T_7	PRD 75% ETc + F	4.00	29.00	64.00	32.33	5.00	30.00	65.00	33.33
T_8	RDI 50% ETc + F	4.00	39.00	59.00	34.00	5.00	40.33	60.00	35.00
T_9	PRD 50% ETc +F	4.00	34.00	69.00	35.66	5.00	35.00	70.00	36.33
T_{10}	No Irrigation	15.00	54.00	84.00	51.00	16.60	55.00	85.00	52.20
Mean		8.10	40.50	71.00		9.16	41.50	72.20	
CD 0.05 (A)					1.88				1.34
CD 0.05 (B)					N.S.				N.S.
CD 0.05 (AxB)					N.S.				N.S.

contents. This result is in agreement with the findings of Proietti and Antognozzi, (1996) on olive and Abdel-Razik, (2012) on mango fruit who reported that increasing irrigation water decreased the fruit firmness and vice versa. Hosakote *et al.* (2006) also observed that softening in fruit texture from unripe to ripe stage of mango was a result of a decrease in starch content, pectin, cellulose and hemicelluloses.

Fruit decay: The data depicted in Table 4 shows that the percent decay loss in mango cv. Dashehari as affected by different treatments increased with the increase in storage period. On mean value basis maximum decay loss (51.00 %) was recorded in T_{10} (no irrigation) whereas, minimum decay loss (32.33 %) was recorded in T_7 (PRD 75 % ETc + F) throughout the storage period. On mean value basis minimum decay loss was recorded on 6th day of storage (8.10 %) which increased significantly and continuously upto 10th the day of storage (71.00 %) and it was observed that data was non significant irrespective of the treatment during both the years 2017 and 2018. Interaction between treatments and storage was also observed to be non significant. Percent decay loss was higher in the year 2018 as compared to year 2017 irrespective of treatments and showed similar increase with increase in storage period as in 2017-2018.

The reduction in fruit decay with calcium may possibly be due to its beneficial effect on firmness of fruit tissues by retarding the rate of respiration and prevent the cellular disintegration by maintaining protein synthesis, which leads to delay in senescence. These results corroborate with the findings of Singh *et al.* (1987) in mango, Siddiqui *et al.* (1989) in ber. Abdel-Razik (2012) reported that the reduction in irrigation water from 100% to 70% ETc decreased the decayed fruit percentage in storage. The increase in number of days under storage increased the decayed fruit percentage. It seems that after reaching ripening stage in storage, the percentage of decayed fruits increased drastically.

The present investigation reveals that out of various deficit irrigation methods T_9 *i.e.* PRD 50% ETc + Fertigation expressed the best result in improving the shelf life of mango fruit with maximum fruit firmness, fruit moisture content and minimum physiological loss in weight.

References

Abdel-Razik, A.M. 2012. Effect of different irrigation regimes on quality and storability of mango fruits (*Mangifera indica* L.). *Journal of Horticultural Science & Ornamental Plants,* 4(3): 247-252.

Barman, K., V.B. Patel, R.R. Singh, M. Prasad and P. Kumari, 2015. Effect of harvesting time and de-sapping on sapburn and quality in mango (*Mangifera indica*) cv. Langra. *Indian Journal of Agricultural Sciences,* 85(7): 945-9.

Bhat, A., R.K. Kaul, M, Reshi and N. Gupta, 2014. Effect of polyamines on shelf life and chilling injury of mango cv. Dashehari. *The Bioscan,* 9(3): 1097-1100.

Davies, W.J., M.A. Bacon, D.S. Thompson, W. Sobeih and L.G. Rodriguez, 2000. Regulation of leaf and fruit growth in plants growing in drying soil: exploitation of the plants' chemical signalling system and hydraulic architecture to increase the efficiency of water use in agriculture. *Journal of Experimental Botany*, 51(350): 1617-1626.

Davies, W.J., S. Wilkinson and B. Loveys, 2002. Stomatal control by chemical signalling and the exploitation of this mechanism to increase water use efficiency in agriculture. *New Phytologist*, 153: 449-460

Dry, P.R., B.R. Loveys, M. Stoll, D. Steward and M.G. McCarthy, 2000. Partial rootzone drying-An update. *Australian Grapegrower and Winemaker,* 438: 35-39.

Gupta, O.P. and N. Mehta, 1988. Effect of pre harvest application on the shelf life of ber (*Zizyphus maurtiana* Lamk) fruits cv. Gola. *Haryana Journal of Horticultural Sciences,* 17(3-4): 183-189.

Hosakote, M.Y., N.P. Tyakal and N.T. Rudrapatnam, 2006. Mango ripening: Changes in cell wall constituents in relation to textural softening. *Journal of the Science of Food and Agriculture,* 86(5): 713-21.

Kumar, A., R.K. Singh, A.K. Sinha, H.K. Singh and A.P. Mishra, 2007. Effect of fertigation on banana through drip irrigation in North Bihar. *J. Res. Birsa Agric. Univ.,* 19:81-86.

Lo Bianco, R., G. Talluto and V. Farina, 2007. Growth, fruit yield and quality of Golden Delicious apple tree under fixed partial rootzone drying. *Journal of Applied Horticulture,* 9(1): 50-55.

Mahajan, B.V.C. and R.C. Sharma, 2000. Effect of pre-harvest applications of growth regulators and calcium chloride on physico-chemical characteristics and storage life of peach (*Prunus Persica* Batcch) cv. Shane-e-punjab. *Haryana Journal of Horticultural Sciences,* 29(1-2): 41-43.

Mercier, V. , C. Bussi, F. Lescourret and M. Genard, 2009. Effects of different irrigation regimes applied during the final stage of rapid growth on an early maturing peach cultivar. *Irrigation Science,* 27(4): 297-306.

Nagaz, K., M.M. Masmoudi and N. Ben Mechlia, 2012. Effect of deficit drip-irrigation scheduling regimes with saline water on pepper yield, water productivity and soil salinity under arid conditions of Tunisia. *Journal of Applied Horticulture*, 14(1): 18-24.

Panse, V. G. and P.V. Sukhatme, 2000. *Statistical Methods for Agricultural Workers*. Publication and Information Division of ICAR, New Delhi.

Pickering, A.H., M.H. Behboudian and T.M. Mills, 2002. Stress physiology of the grapevine: An overview. In: *Recent Research Developments in Plant Biology*. Part 2. S.G. Pandulai (Ed.), Research signopost, Kerala, India, pp: 303-320.

Proietti, P. and E. Antognozzi, 1996. Effect of irrigation on fruit quality of table olive (*Olea europea),* cultivar Ascoland tenera. *New Zealand Journal Crop Hort. Sci.,* 24: 175-181.

Rathore, H.A., T. Masud, S. Sammi and A.H. Soomre, 2007. Effect of storage on physico-chemical composition and sensory properties of mango (*Mangifera indica* L.) variety Dasehari. *Pakistan Journal of Nutrition,* 6(2): 143-148.

Sharma, A., D. Kour, V.K. Wali, P. Bakshi, B. Sharma and N. Gupta, 2017. Effect of irrigation intervals and calcium sprays on shelf life of litchi (*Litchi chinensis* Sonn.) cv. Dehradun. *The Bioscan,* 12(3): 1597:1601.

Siddiqui, S., O.P. Gupta and R. Yamdagni, 1989. Effect of preharvest sprays on chemicals on shelf life of ber (*Zizyphus maurtiana* Lamk) cv. Umran. *Harayana Journal of Horticultural Sciences,* 18(3-4): 177-183.

Singh, H.K. and K.S. Chauhan, 1993. Effect of pre-harvest calcium nitrate spray on peach on the storage of life of fruits. *Ind. J. Agric. Sci.,* 32: 235-239.

Singh, R.N., G. Singh, J.S. Mishra and O.P. Rao, 1987. Studies on the effect of pre- and postharvest treatment of calcium nitrate and calcium chloride on the storage of Amarpali mango. *Progressive Horticulture,* 19(1-2): 1-9.

Wills, R.B.H., B. McGlasson, D. Graham and D. Joyce, 1998. *Postharvest: An Introduction to the Physiology and Handling of Fruit, Vegetables and Ornamentals.* (4th ed). CAB International, New York.

Received: July, 2021; Revised: October, 2021; Accepted: October, 2021