

## STUDIES ON SHELF LIFE AND QUALITY OF DRAGON FRUITS AS INFLUENCED BY POSTHARVEST TREATMENTS

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### Abstract

The study aimed to assess the shelf life and quality of red and white fleshed dragon fruit under various postharvest treatments at the Horticulture Division of Bangladesh Institute of Nuclear Agriculture, Mymensingh during the period from November 2023 to January 2024. The experiment was laid out in completely randomized design included two factors such as Factor A: Variety ( $V_1$  = red fleshed,  $V_2$  = white fleshed) and Factor B: Postharvest treatments ( $T_1$ : control,  $T_2$ : 12.5 $\mu$ m LDPE bag,  $T_3$ : gamma irradiation @ 1000 Gy + LDPE bag,  $T_4$ : 3% NaOCl dip (10 minutes) + LDPE bag,  $T_5$ : 3% CaCl<sub>2</sub> dip (10 minutes) + LDPE bag,  $T_6$ : storing at 4°C + LDPE bag). The parameters studied were weight loss, firmness, titratable acidity (TA), total soluble solids (TSS), disease severity and shelf life. Red fleshed fruit showed superior firmness (2.22), TA (0.33%) and TSS (13.80% Brix). Whereas, white fleshed fruit demonstrated lower weight loss (6.01%) and disease severity (3.72) at the 11th day of storage. White fleshed fruit also had a slightly longer shelf life (15.44 days). Among treatments,  $T_6$  significantly extended shelf life to 51.88 days. In combined effects,  $V_1T_6$  showed better TA (0.37%) and TSS (12.93% Brix), while  $V_2T_6$  minimized weight loss (0.84%). The longest shelf life (52.50 days) was observed in  $V_2T_6$ . The findings would greatly contribute in reducing postharvest loss of dragon fruits and maintain their quality during marketing at ambient condition.

**Key words:** Dragon fruit, gamma irradiation, Shelf life, CaCl<sub>2</sub>, Storage temperature.

### Introduction

Dragon fruit (*Hylocereus* spp.), a member of the Cactaceae family, is an exotic, tropical fruit known for its vibrant color, delicate taste and nutritional value. Native to Mexico and Central America, it is now cultivated globally, especially in Vietnam and Southeast Asia (Wakchaure *et al.*, 2021). Dragon fruit is hardy, thriving in drought-prone, arid regions and is commercially valuable for its adaptability to various agro-climatic conditions (Chandran, 2009). It is rich in vitamin C, calcium, potassium and fiber, making it a popular choice for health-conscious consumers (Rao and Sasanka, 2015).

In Bangladesh, dragon fruit cultivation has grown significantly, with the area under cultivation expanding from 38 hectares in 2015-2016 to 2,095 hectares in 2022-2023 (Khosru, 2023). Despite this growth, short shelf life (5-7 days) poses challenges for its marketability and causes significant postharvest losses. The need for effective postharvest management techniques, including standardized harvesting, packaging and storage, is crucial for reducing waste and maintaining quality (Ali *et al.*, 2013).

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Gamma irradiation has been shown to reduce mold, bacterial contamination and delay ripening, extending the shelf life of fresh produce (Khan *et al.*, 2012). Research by Castro *et al.* (2020) demonstrated that using modified atmosphere packaging (MAP) reduced decay in harvested Dragon fruit. Similarly, MAP and chemical treatments like CaCl<sub>2</sub> and NaOCl are known to enhance fruit quality by reducing weight loss, slowing ripening and increasing shelf life (Vivek *et al.*, 2016; Dhakal, 2020). However, limited research has been conducted on the impact of these techniques on dragon fruit in Bangladesh.

Therefore, the present study was undertaken to evaluate the effectiveness of gamma irradiation, chemical treatments and MAP in extending the shelf life and maintaining the quality of dragon fruit under ambient conditions. Specifically, the study aims to examine the efficacy of low temperature in prolonging shelf life, standardize the use of CaCl<sub>2</sub>, NaOCl and MAP to reduce postharvest loss, enhance quality and recommend technologies for long-term storage of dragon fruit without compromising its quality.

### Materials and Methods

This experiment was conducted at the Postharvest Laboratory of the Horticulture Division, Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh during the period from November 2023 to January 2024 to extend the shelf life and quality of dragon fruit using gamma irradiation, sanitizers and modified atmosphere packaging (MAP) under ambient conditions. Two varieties namely V1= red fleshed dragon fruit (*Hylocereus polyrhizus*) and V2= white fleshed dragon fruit (*Hylocereus undatus*), were studied with 108 uniform, disease free fruit. A two-factorial completely randomized design (CRD) with three replications of three fruits each was used. Postharvest treatments included: T<sub>1</sub> (control), T<sub>2</sub> (12.5µm LDPE bag), T<sub>3</sub> (gamma irradiation + LDPE bag), T<sub>4</sub> (3% NaOCl dip for 10 min + LDPE bag), T<sub>5</sub> (3% CaCl<sub>2</sub> dip for 10 min + LDPE bag) and T<sub>6</sub> (storage at 4°C + LDPE bag). Fruits were stored at ambient conditions except T<sub>6</sub>. Weight loss, firmness, titratable acidity, TSS and disease severity were recorded every alternate day during storage.

### Observation

Data were recorded every alternate day during storage, covering physical (weight loss, colour, and firmness), physico-chemical (titratable acidity, P<sup>H</sup> and total soluble solids), microbial parameters (disease incidence and disease severity) and shelf life of the dragon fruit.

### Methods of Studying Parameters

#### Estimation of weight loss

Weight loss (%) was calculated using the formula (Akhtar *et al.*, 2010):

$$\text{Weight Loss (\%)} = \frac{\text{IW} - \text{FW}}{\text{IW}} \times 100$$

Here, IW = Initial weight (gm)  
FW = Final weight (gm)

### Estimation of firmness

Fruit firmness were rated on a scale of 1-5: 1 = Rotten, 2 = Very soft, 3 = Soft, 4 = Hard, 5 = Very hard.

### Estimation of titratable acidity

Titratable acidity was measured by titrating with 0.1 N NaOH and calculated as percentage.

$$\text{Titratable Acidity (\%)} = \frac{V_{\text{NaOH}} \times N_{\text{NaOH}} \times M_{\text{acid}} \times 100}{V_{\text{sample}}}$$

Where,  $V_{\text{NaOH}}$  = NaOH used (in mL)

$N_{\text{NaOH}}$  = normality of the NaOH solution (in N)

$M_{\text{acid}}$  = molar mass of malic acid (g/mol)

$V_{\text{sample}}$  = volume of the sample taken (in mL)

### Estimation of total soluble solids (TSS)

TSS was measured using a Brix refractometer.

### Disease severity

Using a five-point rating scale, disease severity was recorded (Corkidi *et al.*, 2006).

### Shelf life

Shelf life was determined as the time until fruits became unacceptable based on weight loss, firmness and disease severity.

### Statistical analysis

The data were analyzed using ANOVA with the “STATISTIX 10” software. The LSD tests were used to compare mean differences at 1% and 5% significance levels (Gomez and Gomez, 1984).

## Result and Discussion

### Effect of variety, postharvest treatments and their interaction on weight loss (%) of dragon fruit

There was a significant variation in weight loss between dragon fruit varieties.  $V_1$  had a weight loss of 10.48%,  $V_2$  had a weight loss of 6.01% at the 11<sup>th</sup> days after storage (DAS). Postharvest treatments significantly reduced weight loss, with the lowest loss (1.1%) in fruits treated with  $T_6$  and the highest (17.35%) in  $T_1$  at 11<sup>th</sup> DAS. The best results were found in  $V_2T_6$ , which showed only 0.84% weight loss. In contrast, the highest weight loss (22.26%) occurred in  $V_1T_1$  at the 11<sup>th</sup> DAS. These results align with studies by Castro *et al.* (2020) and Gupta *et al.* (2011), highlighting the effectiveness of low-temperature storage

and modified atmosphere packaging in reducing weight loss. Mir and Beaudry (2016) also found that MAP helped maintain red-fleshed Dragon fruit quality (Table 1).

**Table 1. Effect of variety, postharvest treatments and their interaction on the weight loss of Dragon fruit**

<b>Main effect of variety</b>									
Variety	Weight loss (%) at different days after storage								
	1	3	5	7	9	11			
V <sub>1</sub>	1.38	2.79	4.38	6.22	8.53	10.48			
V <sub>2</sub>	0.82	1.66	2.74	3.74	5.01	6.01			
LSD <sub>0.01</sub>	0.33	0.37	0.40	0.50	0.39	0.61			
Level of sig.	**	**	**	**	**	**			
<b>Main effect of postharvest treatments</b>									
T <sub>1</sub>	2.70	4.61	6.88	10.12	14.46	17.35			
T <sub>2</sub>	0.67	2.25	3.25	4.76	6.69	8.48			
T <sub>3</sub>	1.10	2.23	3.74	5.15	7.20	9.12			
T <sub>4</sub>	1.06	2.01	3.72	4.75	6.27	7.69			
T <sub>5</sub>	0.87	1.81	3.09	4.24	4.93	5.74			
T <sub>6</sub>	0.20	0.45	0.66	0.86	1.06	1.10			
LSD <sub>0.01</sub>	0.57	0.65	0.69	0.87	0.68	1.06			
Level of sig.	**	**	**	**	**	**			
<b>Interaction effect of variety and postharvest treatments</b>									
Treatment combinations	Weight loss (%) at different days after storage								
	1	3	5	7	9	11	30	45	60
V <sub>1</sub> T <sub>1</sub>	3.20	5.02	7.77	11.72	17.84	22.26	-	-	-
V <sub>1</sub> T <sub>2</sub>	0.58	2.00	3.87	6.02	8.77	11.22	-	-	-
V <sub>1</sub> T <sub>3</sub>	1.81	3.77	5.29	6.83	9.20	11.47	-	-	-
V <sub>1</sub> T <sub>4</sub>	1.35	2.99	4.80	6.28	7.92	9.56	-	-	-
V <sub>1</sub> T <sub>5</sub>	1.03	2.33	3.76	5.44	6.09	7.00	-	-	-
V <sub>1</sub> T <sub>6</sub>	0.30	0.61	0.76	1.07	1.36	1.36	2.64	4.21	6.48
V <sub>2</sub> T <sub>1</sub>	2.20	4.21	5.99	8.53	11.08	12.45	-	-	-
V <sub>2</sub> T <sub>2</sub>	0.76	1.61	2.63	3.50	4.62	5.74	-	-	-
V <sub>2</sub> T <sub>3</sub>	0.38	0.73	2.19	3.47	5.21	6.77	-	-	-
V <sub>2</sub> T <sub>4</sub>	0.77	1.46	2.64	3.23	4.63	5.81	-	-	-
V <sub>2</sub> T <sub>5</sub>	0.72	1.70	2.41	3.05	3.76	4.48	-	-	-
V <sub>2</sub> T <sub>6</sub>	0.09	0.28	0.56	0.65	0.75	0.84	2.11	3.23	4.51
LSD <sub>0.01</sub>	0.81	0.92	0.98	1.22	0.96	1.50	-	-	-
Level of sig.	**	**	**	**	**	**	ND	ND	ND

\*\* = Significant at 1% level of probability, ND =Statistical analysis not done.

**Effect of variety, postharvest treatments and their interaction on firmness of dragon fruit**

There was no significant variation in firmness between V<sub>1</sub> and V<sub>2</sub> with firmness scores of 2.22 and 2.11 respectively at the 11<sup>th</sup> DAS. However, postharvest treatments significantly influenced firmness retention capacity. The lowest firmness change score

(1.00) was found in T<sub>1</sub>, while the highest firmness score (5.00) was observed in fruits treated with T<sub>6</sub> at the 11th DAS. The interaction effect, the best results were obtained for both V<sub>1</sub>T<sub>6</sub> and V<sub>2</sub>T<sub>6</sub>, with firmness change scores 3.50 and 3.66 respectively at the 60<sup>th</sup> DAS. These results are consistent with Castro *et al.* (2020) and Ambuko *et al.* (2018), who found that MAP and low-temperature storage effectively preserved the firmness of dragon fruit. Bagheri *et al.* (2015) also reported that CaCl<sub>2</sub> treatments effectively maintained the firmness of persimmon (Table 2).

**Table 2. Effect of variety, postharvest treatments and their interaction on firmness of Dragon fruit**

<b>Main effect of variety</b>									
Variety	Fruit firmness at different days after storage								
	1	3	5	7	9	11			
V <sub>1</sub>	5.00	5.00	4.28	3.72	2.94	2.22			
V <sub>2</sub>	5.00	5.00	4.22	3.56	2.67	2.11			
LSD <sub>0.05</sub>	-	-	0.29	0.28	0.32	0.27			
Level of sig.	ND	ND	NS	NS	NS	NS			
<b>Main effect of postharvest treatments</b>									
T <sub>1</sub>	5.00	5.00	3.83	3.00	1.83	1.00			
T <sub>2</sub>	5.00	5.00	4.00	3.33	2.17	1.33			
T <sub>3</sub>	5.00	5.00	4.00	3.50	2.50	1.33			
T <sub>4</sub>	5.00	5.00	4.17	3.50	2.67	1.83			
T <sub>5</sub>	5.00	5.00	4.50	3.50	2.67	2.50			
T <sub>6</sub>	5.00	5.00	5.00	5.00	5.00	5.00			
LSD <sub>0.01</sub>	-	-	0.67	0.67	0.77	0.64			
Level of sig.	ND	ND	**	**	**	**			
<b>Combined effects of variety and postharvest treatments</b>									
Treatment combinations	Fruit firmness at different days after storage								
	1	3	5	7	9	11	30	45	60
V <sub>1</sub> T <sub>1</sub>	5.00	5.00	4.00	3.00	2.00	1.00	-	-	-
V <sub>1</sub> T <sub>2</sub>	5.00	5.00	4.00	3.33	2.67	1.67	-	-	-
V <sub>1</sub> T <sub>3</sub>	5.00	5.00	4.33	3.67	2.67	1.33	-	-	-
V <sub>1</sub> T <sub>4</sub>	5.00	5.00	4.00	3.67	2.67	1.67	-	-	-
V <sub>1</sub> T <sub>5</sub>	5.00	5.00	4.33	3.67	2.67	2.67	-	-	-
V <sub>1</sub> T <sub>6</sub>	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.00	3.50
V <sub>2</sub> T <sub>1</sub>	5.00	5.00	3.67	3.00	1.67	1.00	-	-	-
V <sub>2</sub> T <sub>2</sub>	5.00	5.00	4.00	3.33	1.67	1.00	-	-	-
V <sub>2</sub> T <sub>3</sub>	5.00	5.00	3.67	3.33	2.33	1.33	-	-	-
V <sub>2</sub> T <sub>4</sub>	5.00	5.00	4.33	3.33	2.67	2.00	-	-	-
V <sub>2</sub> T <sub>5</sub>	5.00	5.00	4.67	3.33	2.67	2.33	-	-	-
V <sub>2</sub> T <sub>6</sub>	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.33	3.66
LSD <sub>0.01</sub>	-	-	0.96	0.95	1.09	0.91	-	-	-
Level of sig.	ND	ND	**	**	**	**	ND	ND	ND

\*\* = Significant at 1% level of probability, \* = Significant at 5% level of probability  
 ND = Statistical analysis not done.

### Effect of variety, postharvest treatments and their interaction on Titratable acidity (%) of dragon fruit

Significant variation in titratable acidity (TA) was observed between the two varieties. The V<sub>1</sub> had 0.33% TA, while, V<sub>2</sub> had 0.37% TA. Both the varieties showed a gradual decrease in TA by 21.07% and 25.58% respectively at 11<sup>th</sup> DAS. Postharvest treatments significantly affected TA. The lowest TA (0.30%) was found in fruits treated with T<sub>1</sub>, while the highest (0.50%) was in fruits treated with T<sub>6</sub> and T<sub>5</sub> maintained 0.46% TA (Table 3a). The interaction effect showed that V<sub>2</sub>T<sub>6</sub> retained the highest TA (0.60%), while V<sub>1</sub>T<sub>1</sub> had the lowest (0.25%) TA at 11<sup>th</sup> DAS. At the 60th DAS, V<sub>1</sub>T<sub>6</sub> and V<sub>2</sub>T<sub>6</sub> both did well, with TA values of 0.24% and 0.38% (Table 3b). These results are consistent with findings by Githiga *et al.* (2014), Islam *et al.* (2022) and Bi *et al.* (2022), who reported a gradual decline in TA during storage, influenced by treatment variations.

**Table 3a. Effect of variety, postharvest treatments and their interaction on titratable acidity (%) of dragon fruit**

<b>Main effect of variety</b>							
Variety	Titratable acidity (%) at different days after storage						
	2	5		8		11	
	TA	% Reduction	TA	% Reduction	TA	% Reduction	
V <sub>1</sub>	0.42	0.39	8.56	0.37	12.80	0.33	21.07
V <sub>2</sub>	0.62	0.57	7.69	0.46	40.35	0.37	25.58
LSD <sub>0.01</sub>	0.02	0.02	-	0.02	-	0.01	-
Level of significance	**	**	-	**	-	**	-
<b>Main effect of postharvest treatments</b>							
T <sub>1</sub>	0.51	0.44	12.79	0.38	25.89	0.30	40.46
T <sub>2</sub>	0.49	0.44	10.69	0.41	17.20	0.33	32.83
T <sub>3</sub>	0.52	0.45	13.34	0.42	20.36	0.38	27.79
T <sub>4</sub>	0.57	0.53	7.41	0.46	19.34	0.41	28.04
T <sub>5</sub>	0.51	0.50	2.70	0.49	5.57	0.46	10.49
T <sub>6</sub>	0.51	0.51	1.50	0.50	2.08	0.50	2.78
LSD <sub>0.01</sub>	0.03	0.03	-	0.03	-	0.02	-
LSD <sub>0.05</sub>	0.02	0.02	-	0.02	-	0.02	-
Level of sig.	**	**	-	**	-	**	-

\*\* = Significant at 1% level of probability

**Table 3b: Interaction effect of variety and postharvest treatments on titratable acidity (%) of Dragon fruit**

Treatment combinations	Titratable acidity (%) at different days after storage													
	2	5		8		11		30		45		60		
		TA	% Reduction											
V <sub>1</sub> T <sub>1</sub>	0.40	0.35	13.22	0.32	21.72	0.25	37.04	-	-	-	-	-	-	
V <sub>1</sub> T <sub>2</sub>	0.40	0.36	11.00	0.36	10.48	0.28	30.73	-	-	-	-	-	-	
V <sub>1</sub> T <sub>3</sub>	0.43	0.37	13.00	0.37	14.49	0.35	17.84	-	-	-	-	-	-	
V <sub>1</sub> T <sub>4</sub>	0.48	0.44	9.12	0.37	22.76	0.35	27.11	-	-	-	-	-	-	
V <sub>1</sub> T <sub>5</sub>	0.41	0.40	2.06	0.39	4.66	0.36	12.32	-	-	-	-	-	-	
V <sub>1</sub> T <sub>6</sub>	0.42	0.40	2.89	0.40	3.68	0.37	12.52	0.32	23.8	0.27	37.5	0.24	45.2	
V <sub>2</sub> T <sub>1</sub>	0.62	0.54	12.52	0.44	28.63	0.39	37.27	-	-	-	-	-	-	
V <sub>2</sub> T <sub>2</sub>	0.59	0.53	10.47	0.46	21.81	0.40	32.01	-	-	-	-	-	-	
V <sub>2</sub> T <sub>3</sub>	0.61	0.53	13.58	0.46	24.46	0.40	34.78	-	-	-	-	-	-	
V <sub>2</sub> T <sub>4</sub>	0.66	0.62	6.15	0.55	16.80	0.46	30.00	-	-	-	-	-	-	
V <sub>2</sub> T <sub>5</sub>	0.62	0.60	3.12	0.58	6.18	0.56	9.52	-	-	-	-	-	-	
V <sub>2</sub> T <sub>6</sub>	0.61	0.61	0.54	0.61	0.98	0.60	2.15	0.52	14.8	0.43	31.1	0.38	37.7	
LSD <sub>0.01</sub>	0.05	0.04	-	0.04	-	0.03	-	-	-	-	-	-	-	
LSD <sub>0.05</sub>	0.03	0.03	-	0.03	-	0.02	-	-	-	-	-	-	-	
Level of sig.	**	**	-	**	-	**	-	ND	-	ND	-	ND	-	

\*\* = Significant at 1% level of probability.

**Effect of variety, postharvest treatments and their interaction on total soluble solids (TSS) of dragon fruit**

In case of total soluble solids (TSS), significant variation was observed between the dragon fruit varieties. V<sub>1</sub> and V<sub>2</sub> had 13.80% and 13.28% Brix respectively at 11<sup>th</sup> DAS. The TSS initially increased, then gradually decreased throughout the storage period. The postharvest treatments significantly influenced TSS retention and the best retention (13.98% Brix) was observed in fruits treated with T<sub>2</sub>, while the lowest (12.67% Brix) was recorded in fruits treated with T<sub>5</sub>. V<sub>1</sub>T<sub>6</sub> and V<sub>2</sub>T<sub>6</sub> showed minimal changes in TSS with the best results for both varieties (Table 4). These findings are consistent with studies by Pascual *et al.* (2022); Githiga *et al.* (2014); Techavuthiporn & Boonyaritthongchaib, (2016); Perumal *et al.* (2021). They showed that low temperatures and MAP help maintain TSS by reducing respiration rates.

**Table 4. Effect of variety, postharvest treatments and their interaction on total soluble solids (TSS) of Dragon fruit**

<b>Main effect of variety</b>									
	TSS% Brix at different days after storage								
	1	3	5	7	9	11			
V <sub>1</sub>	13.12	14.27	14.16	13.80	13.51	13.80			
V <sub>2</sub>	13.27	13.85	13.64	13.28	13.17	13.28			
LSD <sub>0.01</sub>	0.14	0.16	0.11	0.14	0.19	0.14			
Level of sig.	*	**	**	**	**	**			
<b>Main effect of postharvest treatments</b>									
T <sub>1</sub>	13.30	14.12	14.42	13.83	13.47	13.27			
T <sub>2</sub>	13.48	14.48	14.15	13.98	13.82	13.98			
T <sub>3</sub>	13.37	14.90	14.40	13.77	13.62	13.77			
T <sub>4</sub>	13.48	14.85	14.68	14.15	13.65	14.15			
T <sub>5</sub>	12.77	13.22	12.93	12.67	12.63	12.67			
T <sub>6</sub>	12.67	12.78	12.83	12.83	12.85	12.83			
LSD <sub>0.01</sub>	0.28	0.27	0.19	0.24	0.33	0.25			
Level of sig.	**	**	**	**	**	**			
<b>Interaction effects of variety and postharvest treatments</b>									
Treatment combinations	Total soluble solids at different days after storage								
	1	3	5	7	9	11	30	45	60
V <sub>1</sub> T <sub>1</sub>	13.30	14.23	14.37	13.83	13.57	13.83	-	-	-
V <sub>1</sub> T <sub>2</sub>	13.37	14.53	14.23	14.27	14.03	14.27	-	-	-
V <sub>1</sub> T <sub>3</sub>	13.27	15.17	14.87	14.20	13.80	14.20	-	-	-
V <sub>1</sub> T <sub>4</sub>	13.77	15.40	15.43	14.87	14.07	14.87	-	-	-
V <sub>1</sub> T <sub>5</sub>	12.93	13.33	13.10	12.70	12.63	12.70	-	-	-
V <sub>1</sub> T <sub>6</sub>	12.80	12.93	12.97	12.93	12.97	12.93	13.67	13.39	13.01
V <sub>2</sub> T <sub>1</sub>	13.30	14.00	14.47	13.83	13.37	13.83	-	-	-
V <sub>2</sub> T <sub>2</sub>	13.60	14.43	14.07	13.70	13.60	13.70	-	-	-
V <sub>2</sub> T <sub>3</sub>	13.47	14.63	13.93	13.33	13.43	13.33	-	-	-
V <sub>2</sub> T <sub>4</sub>	13.20	14.30	13.93	13.43	13.23	13.43	-	-	-
V <sub>2</sub> T <sub>5</sub>	12.60	13.10	12.77	12.63	12.63	12.63	-	-	-
V <sub>2</sub> T <sub>6</sub>	12.53	12.63	12.70	12.73	12.73	12.73	13.59	13.33	12.89
LSD <sub>0.01</sub>	0.39	0.39	0.27	0.35	0.47	0.35	-	-	-
Level of sig.	**	**	**	**	**	**	ND	ND	ND

\*\* = Significant at 1% level of probability, ND = Statistical analysis not done.

#### **Effect of variety, postharvest treatments and their interaction on disease severity**

No significant variation in disease severity was observed between V<sub>1</sub> and V<sub>2</sub> with scores of 3.83 and 3.72 respectively at 11<sup>th</sup> DAS. Postharvest treatments significantly reduced disease severity. The lowest severity score (0.00) was found in fruits treated with T<sub>6</sub> and T<sub>5</sub> also had a lower score of 2.00 until 9<sup>th</sup> DAS. In case of interaction effect, V<sub>1</sub>T<sub>6</sub> and V<sub>2</sub>T<sub>6</sub> showed the lowest disease severity (0.00) at 11<sup>th</sup> DAS. While, V<sub>1</sub>T<sub>5</sub> and V<sub>2</sub>T<sub>5</sub> also

performed well (2.00 until 9<sup>th</sup> DAS). The highest severity (5.00) occurred in untreated combinations (V<sub>1</sub>T<sub>1</sub>, and V<sub>2</sub>T<sub>1</sub>) at 11<sup>th</sup> DAS. V<sub>1</sub>T<sub>6</sub> and V<sub>2</sub>T<sub>6</sub> had no disease until day 30 of storage. These results support Jadhav (2018), Ngoc *et al.* (2014) and Punitha *et al.* (2009), those who also found that low temperatures reduce disease severity in fruits (Table 5).

**Table 5. Effect of variety, postharvest treatments and their interaction on disease severity of Dragon fruit**

<b>Main effect of variety</b>									
Variety	Disease severity at different days after storage								
	1	3	5	7	9	11			
V <sub>1</sub>	0.00	0.00	0.28	1.44	2.89	3.83			
V <sub>2</sub>	0.00	0.00	0.28	1.39	2.67	3.72			
LSD <sub>0.05</sub>	-	-	0.22	0.49	0.48	0.18			
Level of sig.	ND	ND	NS	NS	NS	NS			
<b>Main effect of postharvest treatments</b>									
T <sub>1</sub>	0.00	0.00	1.00	3.50	4.67	5.00			
T <sub>2</sub>	0.00	0.00	0.33	2.17	4.00	5.00			
T <sub>3</sub>	0.00	0.00	0.33	2.17	3.50	5.00			
T <sub>4</sub>	0.00	0.00	0.00	0.67	2.50	4.17			
T <sub>5</sub>	0.00	0.00	0.00	0.00	2.00	3.50			
T <sub>6</sub>	0.00	0.00	0.00	0.00	0.00	0.00			
LSD <sub>0.01</sub>	-	-	0.52	1.16	1.14	0.44			
Level of sig.	ND	ND	**	**	**	**			
<b>Interaction effect of variety and postharvest treatments</b>									
Treatment combinations	Disease severity at different days after storage								
	1	3	5	7	9	11	30	45	60
V <sub>1</sub> T <sub>1</sub>	0.00	0.00	1.00	3.67	5.00	5.00	-	-	-
V <sub>1</sub> T <sub>2</sub>	0.00	0.00	0.33	2.33	3.67	5.00	-	-	-
V <sub>1</sub> T <sub>3</sub>	0.00	0.00	0.33	2.00	4.00	5.00	-	-	-
V <sub>1</sub> T <sub>4</sub>	0.00	0.00	0.00	0.67	2.67	4.33	-	-	-
V <sub>1</sub> T <sub>5</sub>	0.00	0.00	0.00	0.00	2.00	3.67	-	-	-
V <sub>1</sub> T <sub>6</sub>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.33	3.67
V <sub>2</sub> T <sub>1</sub>	0.00	0.00	1.00	3.33	4.33	5.00	-	-	-
V <sub>2</sub> T <sub>2</sub>	0.00	0.00	0.33	2.00	4.33	5.00	-	-	-
V <sub>2</sub> T <sub>3</sub>	0.00	0.00	0.33	2.33	3.00	5.00	-	-	-
V <sub>2</sub> T <sub>4</sub>	0.00	0.00	0.00	0.67	2.33	4.00	-	-	-
V <sub>2</sub> T <sub>5</sub>	0.00	0.00	0.00	0.00	2.00	3.33	-	-	-
V <sub>2</sub> T <sub>6</sub>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.67	3.33
LSD <sub>0.01</sub>	-	-	0.74	1.65	1.62	0.62	-	-	-
Level of sig.	ND	ND	**	**	**	**	ND	ND	ND

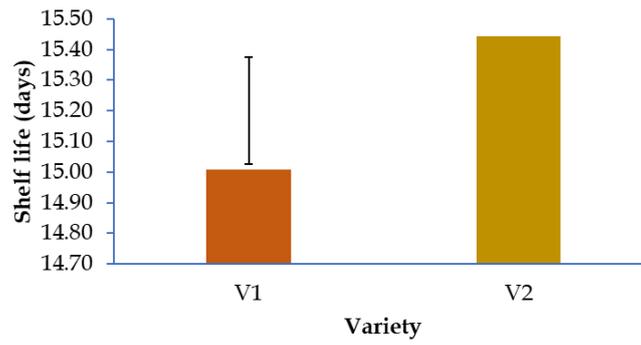
\*\* = Significant at 1% level of probability, \* = Significant at 5% level of probability, ND = Statistical analysis not done, NS = non-significant



Plate 1. Picture showing **A**: red fleshed Dragon fruits and **B**: white fleshed Dragon fruits at 11<sup>th</sup> DAS.

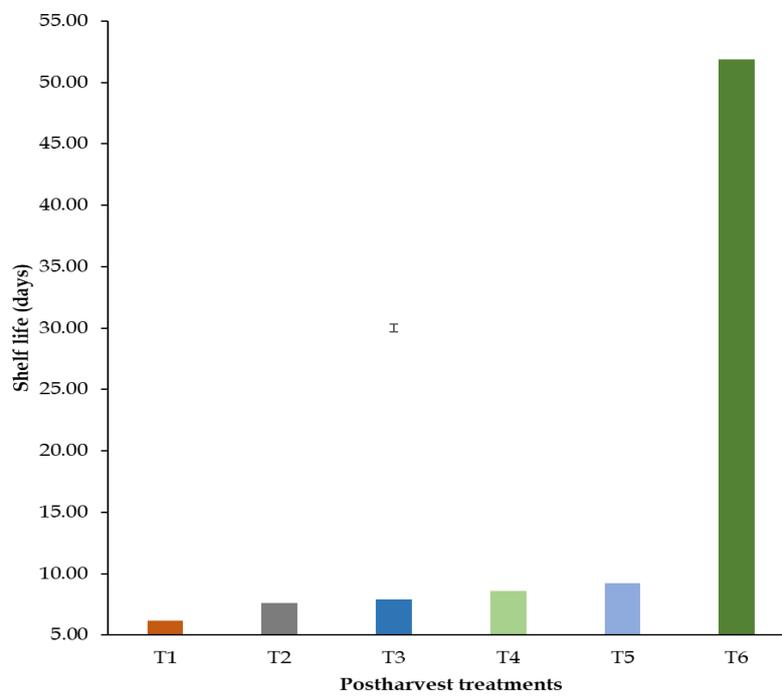
### Effect of variety, postharvest treatments and their interaction on shelf life of dragon fruit

White-fleshed dragon fruits (V<sub>2</sub>) had a significantly longer shelf life (15.44 days) compared to red-fleshed fruits (V<sub>1</sub>) at 15.01 days (Fig. 1). Postharvest treatments significantly extended the shelf life, with the longest shelf life (51.88 days) observed in fruits stored at 4°C with 12.5µm LDPE bags (T<sub>6</sub>) and the shortest (6.19 days) in untreated fruits (T<sub>1</sub>) (Fig. 2). Gamma irradiation (T<sub>3</sub>) and sanitizers (T<sub>4</sub> and T<sub>5</sub>) also effectively prolonged shelf life. The longest shelf life was achieved with V<sub>1</sub>T<sub>6</sub> and V<sub>2</sub>T<sub>6</sub>, with V<sub>2</sub>T<sub>6</sub> showing the longest shelf life of 52.50 days, while the shortest (6.13 days) was recorded in V<sub>1</sub>T<sub>1</sub> (Fig. 3). These findings align with studies by Jadhav (2018), Lata *et al.* (2024), Pascual *et al.* (2017) and Kudchikar *et al.* (2011), confirming that low temperature and proper packaging significantly enhance the shelf life of dragon fruit.



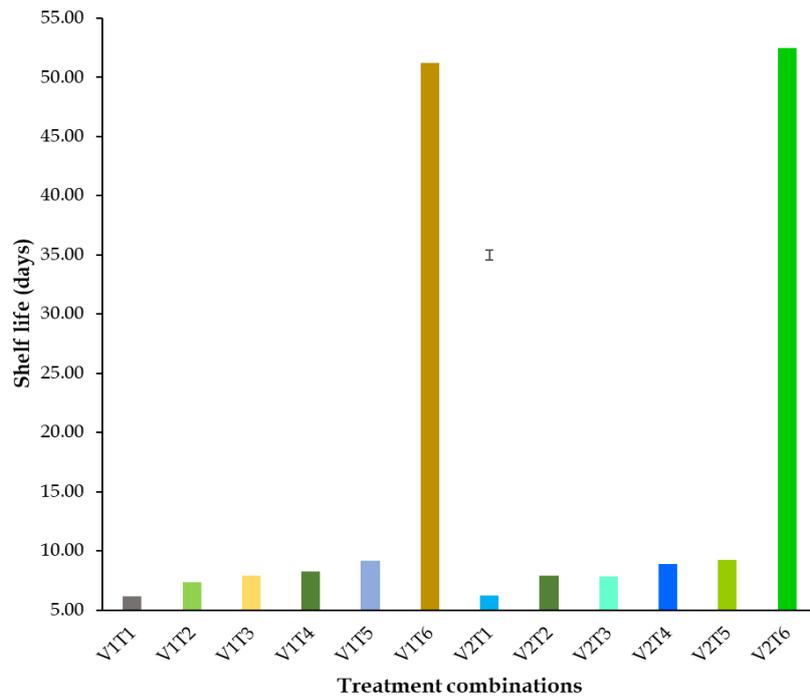
**Fig. 1. The main effect of variety on shelf life of Dragon fruit.**

The vertical bar indicates LSD at 1% level of probability, V<sub>1</sub> = Red fleshed Dragon fruit and V<sub>2</sub> = White fleshed Dragon fruit.



**Fig. 2. The main effect of postharvest treatments on shelf life of Dragon fruit.**

The vertical bar indicates LSD at 1% level of probability.



**Fig. 3. Combined effects of variety and postharvest treatments on shelf life of Dragon fruit. (The vertical bar indicates LSD at 1% level of probability.)**

### Conclusion

The findings of the present study indicate that this experiment can effectively contribute to extending the shelf life and preserving the quality of dragon fruit. The lowest level of weight loss, disease severity, maximum retention of firmness and titratable acidity were found in dragon fruits treated with T<sub>6</sub>. The most striking result of the experiment was that dragon fruits irrespective of T<sub>6</sub> had the highest shelf life (52.50 days – white fleshed; 51.25 days– red fleshed). In absence of low temperature, irradiation and sanitizers (CaCl<sub>2</sub> and NaOCl) were also found effective in extending shelf life at ambient condition.

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