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Effect of Gaseous Composition in Package and Storage Temperature on Physic-Chemical Changes of *Jamun* Fruits during Storage

KEYWORDS: Gaseous Composition, Storage temperature, Physico- chemical change, *Jamun* fruits

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ABSTRACT *Jamun (Syzygium cumini L.) fruit is high perishablity, a substantial quantity goes waste, resulting in heavy post harvest losses. Packaging with modified gaseous compositions and storage temperature are the approaches for enhancing storability of jamun fruits. With this objective the present investigation was conducted in two consecutive fruiting seasons i.e., June-July of 2011 and 2012.. For the experimentations fruits were packed in low density polythene bag (25 µ thicknesses) with two concentrations of oxygen levels (2% and 5%) in combination with three concentrations of carbon dioxide (5%, 10% and 15%) and one control (environmental gaseous composition with 21 per cent O_2 and 0.03 per cent CO_2) after giving treatment stored these samples in three conditions i.e., at ambient, 12ºC and 6ºC temperatures. The stored fruits were examined physic-chemically at 3 day interval up to 15 days of storage. Modified atmospheric packaging conditions were more effective in reducing respiration and ethylene evaluation rate, weight loss and retention of higher ascorbic acid as well as other quality attributes.*

Introduction

Jamun (*Syzygium cumini* L.) popularly known as "Indian blackberry" is one of the important underutilized fruit crop of India. This fruit crops is the part of culture and way of life of tribals as well as rurals of Rajasthan. It is ideally suited for growing in the tropical and sub-tropical parts of India particularly in semi-arid sub tropical region with an annual rainfall varying from 300-350 mm (Vashishtha, 1993). The information regarding the area and production of *jamun* is not available because it is seldom planted in the form of an orchard and generally scattered. It is found extensively in semi arid area of Uttar Pradesh, Madhya Pradesh, Gujarat, Rajasthan, Tamil Nadu, Maharashtra, Haryana, Punjab, Andhra Pradesh and Bihar state of India. The *jamun* fruits are eaten raw and are use to prepare delicious beverages, jam, jelly, sauce, squash, wine, and vinegar. The *jamun* is well recognized in folk medicine and pharmaceutical trade. The fruit is astringent, atomachic, carminature, antiscorbutic and diuretic. The leaves are antibacterial and used for strengthening the teeth and gums, the fruit to cure diabetics, diarrhea, and ringworm (Pareek *et al.*, 2009). Shukla (1979) observed that the storage life of *jamun* fruit is 6 days at room temperature and three weeks at low temperature, when pre-cooled fruit are kept in perforated polythene bags. Due to the *jamun* fruit is high perishablity, a substantial quantity goes waste, resulting in heavy post harvest losses. Packaging with modified gaseous compositions is an approach for enhancing storagability of *jamun* fruits. Keeping this in view the present study was conducted.

Materials and Methods

An experiment was conducted on *jamun* fruits at Department of Horticulture, Rajasthan College of Agriculture during June-July in fruiting season of 2011 and 2012. The physiologically matured fruits at colour turning stage were harvested and packed in low density polythene bag (25 µ thicknesses) with two concentrations of oxygen (2% and 5%) in combination with three concentrations of carbon dioxide (5%, 10% and 15%) and one control (environmental gaseous composition with 21 per cent O_2 and 0.03 per cent CO_2). The packed fruits after giving treatment stored in at ambient (32$\pm$3°C), 12ºC, and 6ºC temperatures. Experiment consists of 21 treatment combinations were evaluated under factorial completely randomized design with three replications. The stored fruit examined for physical (CPLW, firmness, TSS), biochemical (respiration, ethylene evolution, ascorbic acid) and sensory (flavour, colour) changes and chilling injury index at 3 day interval up to 15 days. The CPLW or per cent loss in weight for each treatment during storage was calculated by using following formula:

$$\text{CPLW (\%)} = \frac{\text{Initial weight (g)} - \text{final weight (g)}}{\text{Initial weight (g)}} \times 100$$

Firmness measured by TA.XT Plus/TA.HD Plus Textural Analyzer used for measuring textural properties. Headspace gases of *jamun* packages were determined using a gas analyzer (6600 Head Space Gas Analyzer, Systech Instruments, Oxford, UK). Respiration rate (µl CO_2 $kg^{-1} h^{-1}$) was measured using Head Space Gas Analyzer (model 6600, Systech Instruments, Oxfordshire, UK). Ethylene evaluation rate by using pump module Gas Alert Micro 5 PLD PV (Voilen Canada) it was expressed in µl ethylene kg^{-1} h^{-1}. TSS by hand refract meter and ascorbic acid by DCIP dye method (Rangana, 1986). Flavour and Colour score giving by the panel of 6 judges, who examined acceptance of *jamun* fruits during storage. CI index = Sum (Hedonic scale × number of fruit with corresponding scale number divided by total number of fruits).

Results and Discussion

The result showed that the temperature and storage composition were the main factor affecting postharvest physiology and quality of *jamun* fruits.

The combined effects of gaseous composition and storage temperature on PLW of *jamun* fruits were found to be significant during 9 and 12 day of storage. On 9 and 12 day of storage the minimum CPLW was recorded in G_4T_3 (0.72%) and (2.11%) and maximum in G_1T_1 (2.60%) and (3.51%), respectively. This enhanced rate of weight loss may be acceleration of physiological processes viz, transpiration, respiration and ripening at elevated temperature. Similar results have been obtained in several fruits, such as loquat (Amoros *et al*., 2008; Akbudak and Eris, 2004) and cherries (Kappel *et al*., 2002; Serrano *et al*., 2005). Similarly, on 9, 12 and 15 days of storage the maximum firmness was recorded in G_4T_3 (49.22 N, 46.36 N and 40.18 N), while minimum in G_6 T_1 (19.38N, 18.41 N and 8.00 N), respectively (Table-1). This can be attributed to less activity of enzymes at reduced temperature which are responsible for degradation of cellulose and other pectin substances that imparted firmness to the fruits.

Gaseous composition and storage temperatures on head space O_2 concentration of packed *jamun* fruits were found significantly during storage. Data revealed that on 3 day of storage to end of storage the minimum head space O_2 concentration was found in G_4T_1 (1.05 & 0.39 %) treatment combination against maximum head space O_2 concentration in G_1T_3 (18.88& 8.67%). On head space CO_2 concentration was found significantly different during storage. Minimum head space CO_2 concentration was recorded in G_2T_3 (5.99%) treatment combination against maximum head space CO_2 concentration in G_7T_1 (17.84%) on 3 day. Further, at the end of experimentation period minimum head space CO_2 concentration was recorded in G_2T_3 (10.31%) treatment combination and maximum in G_7T_1 (21.88%). High CO_2 was proposed to inhibit respiration rate by feedback inhibition or by controlling mitochondrial activity including an effect of CO_2 on respiration rate is not clear, since there are examples in which respiration rate has also been increased or non-affected by high CO_2 concentrations (Fonesca *et al*., 2002). The reduced O_2/or enriched CO_2 level reduced respiration rate and decrease ethylene production rate, inhibit or delay enzymatic reaction, alleviated physiological disorders and preserved the fruit quality from losses (Day, 1994; Solvia and Martin, 2003.).

Respiration rate of packed *jamun* fruits were found to be significant during storage. The highest respiration rate was found in G_4T_3 (43.74 ml CO_2 kg^{-1} h^{-1}) and minimum in G_1T_1 (5.09 ml CO_2 kg^{-1} h^{-1}) on 9 days of storage. Similarly, on 15 day of storage the higher respiration rate was observed in G_4T_3 (18.06 ml CO_2 kg^{-1} h^{-1}) and minimum in G_1T_1 (2.36 ml CO_2 kg^{-1} h^{-1}) treatment combinations. However, negative secondary responses to low O_2 on oxidative process, including respiration required for substrate production, although aroma generation is recovered when fruits are restored to normal air (Beaudry, 1999; Kader and Watkins, 2000; Artes *et al*., 2006a).

Regarding ethylene evaluation rate of *jamun* fruits were found significant during storage except 3 days of storage. On 9 days of storage the maximum respiration rate was found in G_4T_3 (41.24 µl C_2H_4 kg^{-1} h^{-1}) and minimum in G_1T_1 (14.06 µl C_2H_4 kg^{-1} h^{-1}). Similarly, on 15 day of storage the higher respiration rate was observed in G_4T_3 (27.11 µl C_2H_4 kg^{-1} h^{-1}) and minimum in G_1T_1 (4.86 µl C_2H_4 kg^{-1} h^{-1}) treatment combinations (table-3). High CO_2 has been found to be a putative inhibitor of ethylene production by repressing 1-aminocyclopropane-1-carboxylic acid (ACC) synthesis and activities of ACC synthase (ACS) or ACC oxidase (ACO) (Kubo *et al*., 1996), whilst moderate CO_2 concentrations can enhance ethylene accumulation (Pretel *et al*., 1999). Low O_2 is known to inhibit 1-aminocyclopropane- 1-caboxylic acid oxides (ACO), one of the key enzymes regulating ethylene biosynthesis, while CO_2 is an antagonist of ethylene action and impedes its autocatalytic synthesis when present at concentration over 1 kPa, these effect being additive to those of low O_2 atmospheres (Artes, *et al.,* 2006).

TSS content of *jamun* fruits was found to be non-significant during storage except 3 day. Similarly, ascorbic acid content was also did not show any significant difference during storage except at the end of storage day i.e., 15 days of storage the maximum ascorbic acid retention was found in G_4T_3 (48.09 mg $100g^{-1}$) and minimum in G_1T_1 (28.04 mg $100g^{-1}$) treatment combination (table-4)

Flavor score was found significant during entire period of storage except initial day of storage, while Colour score at 12^{th} and 15^{th} day of storage exhibited significance. At the end of storage days i.e., on 15 days of storage the maximum flavor score was recorded in G_4T_2 (5.83) and minimum in G_1T_1 (2.97), whereas maximum colour score in G_4T_3 (7.38) and minimum in G_1T_1 (1.96) treatment combination (table-5). Results were in accordance with the findings of Jat, *et al.* (2012) in *ber* and Pandey *et al*., (2006) in aonla.

The combined effect of gaseous composition and storage temperature were significantly affected chilling injury during storage except 3 and 6 day of storage because no chilling injury was observed on 3 and 6 day of storage in all the treatment combinations. On 9 day of storage the maximum chilling injury index was observed in G_1T_3 (0.73) treatment and at 15 day of storage the maximum chilling injury index was observed in G_1T_3 (2.34) and minimum in G_4T_2 (0.61) treatment combination and no chilling injury symptoms were observed on fruit stored at ambient temperature. Generally, CI occurs primarily at the cell membrane with changes in the fatty acid phospholipids composition (Mirdehghan *et al.,* 2007) and the membrane damages initiate a cascade of secondary reactions leading to disruption of cell structures. The beneficial effects of MAP on maintaining fruit quality during postharvest storage is even greater for tropical fruits than for temperate ones, due to the reduction of chilling sensitivity by atmospheres with high CO_2 and O_2 concentrations (Sandhya, 2010).

Thus, the treatments combination G_4T_2 (2% O_2 & 15% CO_2 with 12°C) inhibited the ethylene biosynthesis and fruit softening with substantial reduction in weight loss during storage, can be used effectively to extend the storage life up to 15 days without any adverse effects on quality of *jamun* fruits.

Table-1 Gas composition in package and storage temperature on CPLW and Firmness during storage

Treatme nts	CPLW (%)				Firmness**(Newton)**			
	Storage days							
	3	**9**	**12**	**15**	**3**	**9**	**12**	**15**
G_1 T_1	1.21	2.60	3.51	3.89	48.33	19.39	18.65	8.44
G_2 T_1	1.31	2.48	4.99	6.59	51.59	21.92	20.60	10.29
G_3 T_1	1.16	2.55	3.46	3.74	49.30	20.47	19.94	10.29
G_4 T_1	1.22	2.06	2.50	2.78	66.19	45.79	22.45	14.03
G_5 T_1	0.97	2.23	2.89	3.65	50.13	20.89	18.53	10.56
G_6 T_1	1.27	2.59	3.32	3.52	48.24	19.38	18.41	8.00
G_7 T_1	1.05	1.99	2.47	2.48	55.99	24.67	20.15	11.71
G_1 T_2	0.73	1.66	2.57	2.63	53.59	35.47	35.05	13.21
G_2 T_2	0.62	1.73	3.64	4.12	56.98	39.85	33.30	16.34
G_3 T_2	0.57	1.70	3.57	3.94	54.22	36.86	36.78	15.60
G_4 T_2	0.62	1.37	2.59	2.94	71.90	44.82	41.90	21.81
G_5 T_2	0.38	1.48	2.99	3.86	55.20	37.89	37.53	16.34
G_6 T_2	0.67	1.72	3.43	3.72	53.09	35.12	34.23	12.32
G_7 T_2	0.46	1.31	5.14	6.93	61.66	43.79	38.44	18.14
G_1 T_3	0.58	0.94	2.19	2.91	60.56	40.03	37.86	22.60
G_2 T_3	0.47	0.93	3.01	4.45	63.06	44.16	41.51	32.57
G_3 T_3	0.42	0.89	2.91	4.20	59.27	40.42	40.63	28.40
G_4 T_3	0.48	0.72	2.11	3.14	67.44	49.22	46.36	40.18
G_5 T_3	0.23	0.78	2.44	4.12	55.99	41.60	39.84	30.04
G_6 T_3	0.53	0.90	2.80	3.97	58.05	38.55	37.86	24.85
G_7 T_3	0.31	0.73	4.08	7.24	60.36	46.40	42.92	33.57
SEm±	0.004	0.025	0.049	0.052	0.770	0.695	0.441	0.385
CD (P=0.05)	**NS**	0.07	0.14	**NS**	**NS**	1.96	1.24	1.08

Gaseous composition: G_1= 21% O_2 & 0.03% CO_2, G_2= 2% O_2 & 5% CO_2, G_3= 2% O_2 & 10% CO_2, G_4= 2% O_2 & 15% CO_2, G_5= 5% O_2 & 5% CO_2, G_6= 5% O_2 & 10% CO_2 & G_7= 5% O_2 & 15% CO_2
Storage temperature T_1= ambient (32$\pm$3°C), T_2=12°C & T_3= 6°C

Table-2 Gas composition in package and storage temperature on head space O2 & CO2 during storage

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Treatments (Gaseous composition)	Headspace O_2 (%)				Headspace CO_2 (%)			
	Storage days							
	3	9	12	15	3	9	12	15
$G_1 T_1$	14.39	5.43	6.27	4.46	7.63	12.42	12.39	13.67
$G_2 T_1$	1.49	0.66	0.71	0.62	7.00	10.33	10.65	11.06
$G_3 T_1$	1.18	0.48	0.53	0.46	12.39	14.85	14.74	15.70
$G_4 T_1$	1.05	0.44	0.48	0.39	14.05	18.19	21.54	19.68
$G_5 T_1$	3.62	1.26	1.14	1.04	7.14	10.35	10.92	11.06
$G_6 T_1$	3.22	1.33	1.27	1.22	13.88	18.65	18.97	19.85
$G_7 T_1$	6.78	3.10	1.59	2.41	17.84	21.10	20.88	21.88
$G_1 T_2$	15.47	9.50	8.51	4.66	6.62	11.30	12.00	13.97
$G_2 T_2$	1.59	1.14	0.95	0.63	6.59	9.33	10.24	11.22
$G_3 T_2$	1.26	0.83	0.70	0.46	11.38	13.42	14.19	15.94
$G_4 T_2$	1.12	0.75	0.64	0.39	13.50	16.29	20.56	19.79
$G_5 T_2$	3.85	2.17	1.53	1.07	6.70	9.38	10.54	11.27
$G_6 T_2$	3.44	2.32	1.71	1.27	13.25	16.86	18.26	20.15
$G_7 T_2$	7.14	5.35	2.13	2.51	17.11	19.08	20.10	22.22
$G_1 T_3$	18.88	13.55	13.17	8.67	6.17	10.71	11.18	13.33
$G_2 T_3$	1.98	1.59	1.43	1.14	5.99	8.50	9.16	10.31
$G_3 T_3$	1.55	1.15	1.05	0.82	10.11	12.20	12.67	14.62
$G_4 T_3$	1.38	1.04	0.96	0.70	12.13	14.37	17.90	17.61
$G_5 T_3$	4.75	3.01	2.29	1.92	6.65	8.67	9.56	10.49
$G_6 T_3$	4.25	3.23	2.58	2.30	12.01	15.32	16.31	18.49
$G_7 T_3$	8.22	7.13	2.90	4.36	15.36	17.33	17.95	20.38
SEm±	0.120	0.092	0.046	0.033	0.226	0.139	0.179	0.156
CD (P=0.05)	0.34	0.26	0.13	0.09	0.64	0.39	0.50	0.44

Table-3 Gas composition in package and storage temperature on Respiration & Ethylene evolution during storage

Treatments (Gaseous composition)	Respiration (ml CO_2 kg^{-1} h^{-1})				Ethylene evolution (µl C_2H_4 kg^{-1} h^{-1})			
	Storage days							
	3	9	12	15	3	9	12	15
$G_1 T_1$	41.62	5.09	3.54	2.36	34.62	14.06	10.2	4.86
$G_2 T_1$	42.04	10.30	7.34	4.28	38.09	16.40	11.9	9.73
$G_3 T_1$	42.87	10.85	8.43	5.51	38.75	17.13	12.63	10.85
$G_4 T_1$	43.74	27.11	26.17	12.85	42.11	23.95	19.45	15.13
$G_5 T_1$	41.83	8.18	5.36	2.38	36.83	15.63	11.13	4.92
$G_6 T_1$	42.26	10.34	7.58	4.59	38.1	16.92	11.42	10.34
$G_7 T_1$	43.11	16.00	15.47	10.79	39.95	18.63	16.13	12.85
$G_1 T_2$	43.46	16.56	8.73	4.86	37.12	14.70	10.56	5.09
$G_2 T_2$	46.75	32.21	19.14	9.73	40.59	29.71	26.21	10.30
$G_3 T_2$	48.21	34.47	22.15	11.85	41.25	31.97	28.47	11.85
$G_4 T_2$	53.61	37.67	33.73	15.13	44.61	35.17	31.67	20.99
$G_5 T_2$	45.17	27.06	13.75	4.92	39.33	24.56	21.06	8.18
$G_6 T_2$	47.76	34.41	20.00	10.79	40.60	31.91	28.41	10.79
$G_7 T_2$	51.61	36.21	22.15	12.85	42.45	33.71	29.21	16.00
$G_1 T_3$	47.40	20.23	11.61	7.05	41.11	17.73	12.23	10.70
$G_2 T_3$	51.27	40.98	19.70	10.79	41.85	38.48	32.98	11.79
$G_3 T_3$	52.38	41.62	25.78	13.82	43.21	39.12	33.62	19.53
$G_4 T_3$	63.81	43.74	34.41	18.06	47.64	41.24	35.74	27.11
$G_5 T_3$	50.39	32.24	17.77	6.95	41.27	29.74	24.24	10.06
$G_6 T_3$	51.89	41.04	24.69	13.61	42.81	38.54	33.04	16.52
$G_7 T_3$	56.05	43.46	28.79	15.03	45.55	40.96	35.46	17.06
SEm±	1.323	0.741	0.521	0.279	1.144	0.756	0.636	0.356
CD (P=0.05)	3.777	2.18	1.49	0.79	NS	2.16	1.81	1.02

Table-4 Gas composition in package and storage temperature on TSS and Ascorbic acid during storage

Treatments (Gaseous composition)	TSS (^{0}B)				Ascorbic acid (mg/100g)			
	Storage days							
	3	9	12	15	3	9	12	15
$G_1 T_1$	13.10	16.26	14.62	15.61	36.17	32.01	29.77	28.04
$G_2 T_1$	12.68	15.55	14.33	16.77	39.64	35.35	33.84	32.48
$G_3 T_1$	12.28	15.91	14.16	16.13	41.33	37.11	34.52	33.03
$G_4 T_1$	11.63	15.21	13.71	14.22	47.59	42.95	40.72	38.99
$G_5 T_1$	12.88	16.56	14.74	15.24	35.90	31.83	30.07	29.08
$G_6 T_1$	12.57	15.48	13.95	14.95	39.15	34.75	33.09	31.55
$G_7 T_1$	11.93	15.41	13.89	14.93	40.13	35.38	36.51	31.36
$G_1 T_2$	12.68	14.63	16.09	16.71	38.48	34.33	32.79	31.34
$G_2 T_2$	12.10	13.95	15.71	17.89	42.09	37.83	37.23	36.25
$G_3 T_2$	11.66	14.22	15.47	17.15	43.74	39.61	37.84	36.73
$G_4 T_2$	10.50	13.60	14.99	15.12	50.50	45.98	44.82	43.56
$G_5 T_2$	12.24	14.80	16.11	16.21	37.92	33.88	32.88	32.26
$G_6 T_2$	11.93	13.84	15.25	15.89	41.37	37.01	36.21	35.02
$G_7 T_2$	11.22	13.63	15.03	15.70	41.93	37.23	39.54	34.40
$G_1 T_3$	11.13	14.01	15.18	16.58	42.05	37.73	36.17	35.62
$G_2 T_3$	11.74	13.02	14.48	17.35	45.03	40.73	40.23	40.39
$G_3 T_3$	11.26	13.07	14.06	16.41	46.23	42.13	40.40	40.45
$G_4 T_3$	10.19	12.50	13.62	14.21	53.45	49.00	47.96	48.09
$G_5 T_3$	11.85	13.61	14.64	15.51	40.03	35.98	35.07	35.48
$G_6 T_3$	11.55	12.73	13.86	15.21	43.68	39.32	38.63	38.52
$G_7 T_3$	10.68	11.78	12.90	14.47	41.51	37.44	40.11	36.11
SEm±	0.162	0.158	0.184	0.174	0.466	0.467	0.470	0.459
CD (P=0.05)	0.46	NS	NS	NS	NS	NS	NS	1.29

Table-5 Gas composition in package and storage temperature on flavour and Colour during storage

Treatments (Gaseous composition)	Flavour (out of 9)				Colour (out of 9)			
	Storage days							
	3	9	12	15	3	9	12	15
$G_1 T_1$	6.67	4.08	3.85	2.97	6.28	6.04	3.85	1.96
$G_2 T_1$	7.36	5.44	3.29	3.46	6.40	6.09	4.65	2.98
$G_3 T_1$	6.63	5.07	4.03	3.15	6.78	6.59	4.63	2.87
$G_4 T_1$	6.80	6.75	5.21	5.36	8.08	7.51	5.37	3.41
$G_5 T_1$	7.90	6.57	4.42	4.71	6.75	6.65	4.83	3.37
$G_6 T_1$	6.47	5.81	4.09	4.28	6.96	6.55	4.90	3.02
$G_7 T_1$	7.41	7.35	3.88	5.10	8.20	7.51	7.87	4.49
$G_1 T_2$	6.40	5.47	3.35	3.45	6.46	6.26	4.69	2.54
$G_2 T_2$	6.96	5.98	3.64	3.75	6.54	6.27	5.64	3.84
$G_3 T_2$	6.24	5.58	4.45	3.44	6.90	6.77	5.59	3.68
$G_4 T_2$	6.40	7.45	5.77	5.83	8.24	7.72	6.50	4.39
$G_5 T_2$	7.51	7.22	4.87	5.11	6.87	6.83	5.85	4.33
$G_6 T_2$	6.40	6.38	4.51	4.64	7.09	6.73	5.92	3.88
$G_7 T_2$	7.05	7.02	4.25	5.47	8.29	7.65	6.05	5.56
$G_1 T_3$	6.25	4.18	3.01	3.10	6.69	6.50	4.94	3.76
$G_2 T_3$	6.81	4.94	3.01	3.16	6.62	6.36	5.82	5.59
$G_3 T_3$	6.08	4.37	3.15	3.24	6.90	6.77	5.71	5.32
$G_4 T_3$	6.25	5.53	5.07	5.11	8.25	7.74	8.65	7.38
$G_5 T_3$	7.35	5.28	4.22	4.41	6.87	6.84	5.97	6.26
$G_6 T_3$	6.25	4.67	3.91	4.01	7.08	6.74	6.05	5.61
$G_7 T_3$	6.87	5.60	3.48	4.53	7.95	7.34	6.65	6.36
SEm±	0.085	**0.170**	**0.155**	0.113	0.122	0.148	0.083	0.127
CD (P=0.05)	**NS**	**0.48**	**0.44**	0.32	**NS**	**NS**	0.23	0.36

Table-6 Gas composition in package and storage temperature on chilling injury during storage

Treatments (Gaseous composition)	Chilling injury				
	Storage days				
	3	6	9	12	15
$G_1 T_1$	-	-	0.00	0.00	0.00
$G_2 T_1$	-	-	0.00	0.00	0.00
$G_3 T_1$	-	-	0.00	0.00	0.00
$G_4 T_1$	-	-	0.00	0.00	0.00
$G_5 T_1$	-	-	0.00	0.00	0.00
$G_6 T_1$	-	-	0.00	0.00	0.00
$G_7 T_1$	-	-	0.00	0.00	0.00
$G_1 T_2$	-	-	0.00	1.45	1.64
$G_2 T_2$	-	-	0.00	1.08	1.38
$G_3 T_2$	-	-	0.00	1.02	1.28

G_4 T_2	-	-	0.00	0.36	0.61
G_5 T_2	-	-	0.00	1.18	1.46
G_6 T_2	-	-	0.00	0.89	1.16
G_7 T_2	-	-	0.00	0.64	0.88
G_1 T_3	-	-	0.73	1.95	2.34
G_2 T_3	-	-	0.45	1.34	1.80
G_3 T_3	-	-	0.60	1.44	1.95
G_4 T_3	-	-	0.00	0.47	0.85
G_5 T_3	-	-	0.65	1.59	2.09
G_6 T_3	-	-	0.55	1.19	1.64
G_7 T_3	-	-	0.00	0.85	1.24
SEm±	-	-	0.006	0.011	0.034
CD (P=0.05)	-	-	0.02	0.03	0.10

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