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POSTHARVEST TREATMENTS USED TO REDUCE EXTERNAL CHILLING INJURY IN 'PINKERTON' AVOCADO (*Persea americana* Mill.).

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The 'Pinkerton' avocado cultivar is highly susceptible to mesocarp discolouration, after storage, and this has seriously threatened its export from South Africa. However, recent studies found that reducing the shipping temperature from the standard commercial temperature of 5.5°C to 2°C for this cultivar reduced the severity of the disorder. Unfortunately storage at 2°C has increased the potential development of external chilling injury as fruit are often exposed to these low temperatures for 30 days. In order to market fruit of an overall high quality a solution to this problem was therefore urgently required. In addition it was hoped that the technology could be used on other avocado cultivars which are required to undergo certain phytosanitary treatments, such as cold sterilization, in order to enter certain markets. In this paper we looked at the use of low temperature preconditioning of fruit, prior to storage, while at the same time comparing the use of fruit wraps vs waxed or unwaxed fruit. Results of the study indicated that both the preconditioning period and preconditioning temperature have a significant effect on the success of the treatment in reducing external chilling development. The fruit coating/packaging was also found to have a significant effect on fruit quality with external chilling injury, fruit weight loss, firmness, and days taken to ripening all being significantly affected.

Key words: preconditioning, wax, polybags, weight loss, fruit quality.

TRATAMIENTOS POSCOSECHA UTILIZADOS PARA REDUCIR LAS LESIONES EXTERNAS POR ENFRIAMIENTO EN LOS AGUACATES "PINKERTON" (*Persea americana* Mill).

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El cultivar de aguacate 'Pinkerton' es muy susceptible a la decoloración del mesocarpio posterior al almacenamiento, lo que ha hecho peligrar su exportación desde Sudáfrica. Sin embargo, estudios recientes indicaron la reducción de la temperatura de embarque del estándar comercial de 5,5° C a 2° C para este cultivar reduce la gravedad del problema. Lamentablemente, el almacenamiento a 2° C ha incrementado el riesgo potencial de que las frutas desarrollen lesiones externas por enfriamiento, ya que a menudo se las expone a estas bajas temperaturas durante 30 días. Para poder comercializar fruta de alta calidad general, se necesitaba una solución urgente a este problema. Además, se esperaba poder utilizar la tecnología en otros cultivares de aguacate que deben pasar por ciertos tratamientos fitosanitarios, como esterilización en frío, para poder ingresar a determinados mercados. En este trabajo investigamos la utilización del acondicionamiento, a bajas temperaturas, previo al almacenamiento de las frutas, al tiempo que comparamos la utilización de envolturas para frutas con las frutas enceradas o sin encerar. Los resultados del estudio indicaron que tanto el período de acondicionamiento previo como la temperatura de acondicionamiento previo tuvieron un efecto significativo en el éxito del tratamiento, al reducir el desarrollo de lesiones externas por enfriamiento. También se llegó a la conclusión de que la cobertura o envoltorio de la fruta tuvo un efecto importante sobre la calidad de ésta, más precisamente sobre la presencia de lesiones externas por enfriamiento, la pérdida de peso, la consistencia y el tiempo de maduración de la fruta.

Palabras clave: preacondicionamiento, wax, pérdida de peso, calidad de la fruta.

1. Introduction

The desire to reach distant markets with avocado fruit often means that fruit are subjected to a cold storage period of up to 30 days. Unfortunately, 'Pinkerton' fruit are susceptible to the development of certain physiological disorders during this storage period. Van Rooyen and Bower (2006) found that the development of the disorder most threatening to the export of this cultivar (mesocarp discolouration) could be reduced by storing fruit below the industry norm of 5.5^{o}C, however the potential damage to the fruits' exocarp was increased. Thus a solution was needed that would ensure both good internal and external quality. The ability to store fruit at very low temperatures would also increase the potential for South African fruit to be exported to new markets requiring cold disinfestations prior to entry. Fortunately, certain postharvest techniques have been found to alleviate low temperature injury in various chilling-sensitive commodities. In avocados some success has been achieved by preconditioning fruit at low temperatures prior to cold storage (Woolf *et al*, 2003; Hofman *et al*, 2003). Furthermore, the use of either waxing (Lunt *et al*, 1981) or fruit packaging (Eksteen and Truter, 1985; Wang, 1993; Bower and Jackson, 2003) has also shown various degrees of success. The objective of this study was to compare the efficacy of the above mentioned treatments in reducing external chilling injury in 'Pinkerton' avocados. Fruit weight loss was also monitored as this is also an important factor to consider when exporting fruit and is often thought to be related to chilling injury severity.

2. Materials and Methods

2.1 Plant material and treatments

'Pinkerton' avocado fruit (*Persea americana* Mill.) were obtained from a grower near Wartburg in KwaZulu Natal, RSA (29^{o}27'S, 30^{o}40'E) on 03/08/04 and 23/08/04. One third of the fruit were commercially waxed at the packhouse (Carnuaba Tropical), one third were left unwaxed, and the last third were left unwaxed and individually heat-sealed in 30 µm thick polypropylene bags (polybags) with 9 µm perforations and an anti-mist coating on the interior, on arrival at the University of KwaZulu Natal (6-8 h after harvest). Fruit were further divided into the respective preconditioning treatments, labelled, weighed and visually assessed for any external blemishes, with ten individual fruit replications per treatment (5 fruit being sampled immediately after a treatment and 5 allowed to ripen). Treatments consisted of fruit preconditioned at 10°C, 15°C or 20°C for 1 or 2 d before being placed in storage at either 2°C or 5.5°C. Fruit in the control treatments were placed directly into storage at 2°C or 5.5°C, sampled immediately or left to ripen at 20°C. The polybags were removed once the fruit were removed from storage, to allow for ripening. After each treatment stage (*viz* preconditioning, storage or ripening) the fruit were weighed, fruit firmness was determined and fruit were visually assessed for any signs of external chilling injury or anthracnose (*Colletotrichum gloeosporioides* Penz.). Chilling injury was assessed by giving the external black discolouration (pitting) a visual rating using a scale of 0 to 10, with 0 = no visible discolouration and 10 = 100% of surface area black. The presence of anthracnose was given a score of 0 = no infection and 1 = some infection. After cold storage 5 fruit per treatment were removed for destructive analysis to see if any mesocarp discolouration was present (rated on scale of 0 to 10, with 0 = no discolouration and 10 = 100% of cut surface area black), while the remaining fruit were allowed to reach “eating ripeness”. “Eating ripeness” was determined using a hand-held firmness tester (on a scale of 100 (hard) to 0 (soft), with “eating ripeness” = 50-55 units). The number of days taken to reach “eating ripeness” was recorded for all treatments.

Data was subjected to analysis of variance (ANOVA). Least significant difference (LSD) was used to separate treatment means.

3. Results

3.1 Preconditioning weight loss

The unwaxed and waxed fruit lost significantly ($P < 0.001$) more weight, during the preconditioning treatments, than the fruit individually sealed in polybags, irrespective of temperature, length of conditioning or harvest date (Table I). Keeping the fruit at higher temperatures (*viz* 15°C or 20°C) and for greater periods (2 d) resulted in increased weight loss. Preconditioning the fruit at 10°C and/or placing the fruit in polybags was thus the most successful in terms of reducing weight loss prior to storage.

3.2 Storage weight loss

For both harvest dates the unwaxed fruit lost the most weight during storage followed by the waxed fruit (Table II). Fruit stored at 5.5°C lost significantly ($P < 0.001$) more weight during storage than fruit stored at 2°C. The relative humidity in the 2°C container was 80-85% while that in 5.5°C was at around 75-80%. As the polybags were only removed from the fruit after storage, the difference between storage and preconditioning weight loss could not be determined. Nevertheless, polybag fruit still lost less than 1% of their original fruit weight by the time they were removed from storage. This was attributed to the presence of some free water in the bags after storage, and to readings of a 100%

relative humidity within the bags. Small differences in weight loss were seen between the preconditioning treatments and a significant interaction was found between fruit packaging, preconditioning temperature and storage temperature on the weight loss during storage. During the 30 d storage period the control fruit and fruit preconditioned at 10°C lost more weight than fruit from other treatments (Table II).

3.3 Ripening weight loss

Fruit originally sealed in polybags, lost the most weight during the ripening period compared to the other fruit packaging treatments (Table III). The unconditioned/control fruit and fruit preconditioned for 1 d, irrespective of temperature, lost significantly ($P < 0.001$) more weight than fruit receiving 2 d preconditioning. Furthermore, fruit stored at 2°C lost significantly ($P < 0.001$) more weight during ripening than fruit stored at 5.5°C (Table III).

3.4 Days to ripening

Fruit stored at 2°C, regardless of fruit packaging or harvest date, took significantly ($P < 0.001$) longer to ripen than fruit stored at 5.5°C (Table IV). Fruit packaging also significantly ($P < 0.001$) affected the number of days taken to ripen, with the waxed fruit, stored at 2°C, taking the longest to ripen, for both harvest dates, followed by fruit originally sealed in polybags (Table IV). Harvest date was found to significantly affect ($P < 0.001$) days taken to ripen with fruit harvested on 23/08/04 taking less time overall to ripen than fruit harvested on 03/08/04. The preconditioning treatments, specifically period, were also found to significantly affect the days taken to ripening (Table IV). Weight loss was found to play a significant role in ripening time. The unwaxed fruit consistently lost the most weight during preconditioning and storage and also ripened the fastest, and similarly the fruit stored at 5.5°C lost more weight and subsequently took less time to ripen.

3.5 Fruit firmness

Unwaxed fruit appeared the least firm and polybag fruit the most firm immediately after storage ($P < 0.001$). After storage at 5.5°C all fruit (except the polybag fruit) were less firm than those stored at 2°C (Table V).

3.6 Mesocarp discolouration

Very little mesocarp discolouration was observed in this study, and ratings out of 10 never exceeded 3, with an average below 1 (data not shown). The incidence of mesocarp discolouration was, however, found to be significantly higher in waxed fruit ($P < 0.001$) than in the other treatments.

3.7 External chilling injury

During both harvest dates, regardless of treatment, the external chilling injury severity immediately after storage (Table VI) was never found to exceed 4, out of a possible rating of 10. Nevertheless, the severity of external chilling injury was found to be higher in fruit stored at 2°C than at 5.5°C. Preconditioning treatments significantly affected chilling injury severity, with the lowest ratings being found in the 2 d preconditioning at 10°C treatments, whether fruit were stored at 2°C or 5.5°C. For both harvest dates the waxed fruit appeared to be more severely affected by chilling injury and pitting was often observed around the lenticels of the fruit. Storing fruit in polybags significantly reduced chilling injury, however this was negated to a certain extent by a higher incidence of fungal infections.

3.8 Anthracnose

A higher incidence of anthracnose infection was found at 2°C than in fruit stored at 5.5°C ($P < 0.001$). The waxed and polybag fruit were also more severely affected than the unwaxed fruit ($P < 0.001$) (data not shown).

4. Discussion

Both the preconditioning treatments and the fruit packaging treatments had a significant effect on the weight loss and external chilling injury severity of 'Pinkerton' avocado fruit. The most successful preconditioning treatment, in terms of decreasing chilling injury, appeared to be the treatment in which fruit were held for 2 d at 10°C. Woolf *et al* (2003) and Hofman *et al* (2003) also reported less chilling injury when fruit were conditioned for longer (*viz* 3-4 d at 8°C). In terms of weight loss, the 2 d storage delay, with fruit held at either 15°C or 20°C resulted in the greater weight loss. This was to be expected, as was the greater weight loss of unwaxed fruit, and fruit stored at 5.5°C compared to 2°C. Minimising weight loss prior to storage, and during storage, is thought to be crucial to sustaining membrane integrity and thus the optimal functioning of cells (Wang, 1993). Throughout the study the external chilling injury severity was the lowest in fruit sealed in polybags during preconditioning and storage. However, care should be taken when storing fruit at a relative humidity close to 100%, as this condition is favourable to the spread and growth of pathogens. The higher incidence of anthracnose infections in fruit stored at 2°C and/or in polybags was thought to be related to the increased number of days taken to reach "eating ripeness" after storage (Table IV), as found by Eksteen and Truter (1985).

Chilling injury could not be attributed solely to weight loss, as the waxed fruit in this study were the most significantly affected by chilling injury despite the fact that the unwaxed fruit lost more weight prior to ripening (Table I and II). The higher incidence of chilling injury in the waxed fruit could have been caused by either the thickness or type of the wax not being optimal for very low temperature storage (ie, below the 5.5°C standard) (Johnston and Banks, 1998). In fact, Bower *et al* (2003) found that the type of fruit packaging used in avocados significantly affected the incidence of external chilling damage. The method of wax application can also be detrimental to fruit quality. In avocados, lenticels may become damaged if the brushes used in the application of the wax are too hard.

The role of weight loss in chilling injury development was not always clear in this study, and it is possible that the reduced chilling injury might well have been the result of other biochemical and physiological modifications induced by the conditioning treatments. These changes could include increases in the degree of unsaturation of fatty acids in the membranes, in response to temperature conditioning, which would in turn affect membrane fluidity and permeability. Bower and Jackson (2003) found that carbon dioxide evolution rates were lower in fruit sealed in polybags during storage, than in unwaxed and waxed fruit. Over time this was suspected to result in a decrease in the respiratory requirement for carbohydrates during storage thus possibly leading to a more controlled rate of energy consumption, which would in turn enable the fruit to tolerate the stress induced by low temperature storage.

5. Conclusion

Low temperature preconditioning treatments show great potential in allowing fruit to be stored at very low temperatures while maintaining high fruit quality, thus further studies should try to elucidate how preconditioning treatments acclimatise avocado fruit to these conditions. This would possibly enable the manipulation, or at least management, of these factors preharvest; for example, determining the effect of the fatty acid saturation of membranes on chilling development. The effect of waxing on chilling development also needs further investigation as the formulation and thickness of the wax application may be easier to manipulate in the short term. Furthermore, the method of application, in the packhouse, may need to be slightly modified in accordance with the type of wax used. The use of micro-perforated polypropylene pallet wraps during storage also needs to be considered as this may prove to be more practical in terms of dealing with large fruit numbers.

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TABLE I. Weight loss of unwaxed, waxed and fruit sealed in micro-perforated polypropylene bags, harvested on 03/08/04 or 23/08/04, during the respective preconditioning treatments.

CUADRO I. *Peso pérdida de, encerados y frutas sellados en micro-perforado polipropileno bolsas, cosechadas en 03/08/04 o 23/08/04, durante los respectivos preacondicionamiento tratamientos.*

Precon. time (d)	Precon. temperature (°C)	Weight loss (%) 03/08/04			23/08/04		
		Unwax	Wax	Polybag	Unwax	Wax	Polybag
1	10	0.46	0.33	0.08	0.31	0.21	0.09
	15	0.99	0.76	0.12	1.26	0.81	0.08
	20	1.22	0.97	0.13	1.12	0.87	0.07
2	10	0.64	0.52	0.12	0.60	0.40	0.14
	15	2.07	1.83	0.20	2.08	1.71	0.22
	20	2.59	1.92	0.28	2.01	1.49	0.21
Date = 0.04**			Packaging = 0.05**				
Preconditioning time = 0.04**			Preconditioning temperature = 0.05**				
** = significant ($LSD_{0.001}$); n = 10							

TABLE II. Weight loss of unwaxed, waxed and fruit sealed in micro-perforated polypropylene bags, harvested on 03/08/04 or 23/08/04, during storage at 2°C or 5.5°C (30 d) and after exposure to the various preconditioning treatments

CUADRO II. *Peso pérdida de, encerados y frutas sellados en microperforado polipropileno bolsas, cosechadas en 03/08/04 o 23/08/04, durante el almacenamiento en 2°C o 5.5°C (30 d) y después de la exposición a los diversos tratamientos preacondicionamiento*

Precon. time (d)	Precon. temperature (°C)	Storage temperature (°C)	Weight loss (%) 03/08/04			23/08/04		
			Unwax	Wax	Polybag	Unwax	Wax	Polybag
0	none	2	5.0	3.6	0.5	4.6	3.3	0.4
		5.5	7.6	5.9	0.4	7.1	5.9	0.3
1	10	2	4.7	3.6	0.4	4.3	3.1	0.4
	15		4.1	3.7	0.5	4.3	3.0	0.5
	20		4.6	3.3	1.0	4.0	3.1	0.4
	10	5.5	7.7	5.6	0.4	6.9	5.2	0.4
	15		7.1	5.6	0.5	6.5	5.0	0.5
	20		7.0	5.2	0.6	6.6	5.3	0.5
2	10	2	5.3	3.3	0.4	4.9	3.2	0.4
	15		4.4	3.3	0.8	4.0	3.4	0.5
	20		4.1	2.9	0.7	4.2	3.2	0.6
	10	5.5	7.6	5.7	0.8	7.2	5.5	0.4
	15		6.8	5.2	0.6	6.9	4.3	0.5
	20		6.6	5.0	0.8	6.6	4.3	0.6
Date = 0.1**				Storage temperature = 0.1**				
Packaging = 0.1**				Preconditioning temperature = 0.2**				
** = significant ($LSD_{0.001}$); n = 10								

TABLE III. Weight loss of unwaxed, waxed and fruit sealed in micro-perforated polypropylene bags, harvested on 03/08/04 or 23/08/04, during ripening (after preconditioning and storage at 2°C or 5.5°C (30 d)).

CUADRO III. *Peso pérdida de, encerados y frutas sellados en microperforado polipropileno bolsas, cosechadas en 03/08/04 o 23/08/04, durante maduración (después preacondicionamiento y almacenamiento en 2°C o 5.5°C (30 d)).*

Precon. time (d)	Precon. temperature (°C)	Storage temperature (°C)	Weight loss (%) 03/08/04			23/08/04		
			Unwax	Wax	Polybag	Unwax	Wax	Polybag
0	none	2	8.7	10.2	9.5	8.6	8.0	9.0
		5.5	5.4	4.8	7.5	6.9	6.7	7.7
1	10	2	7.3	8.8	8.4	7.0	7.3	9.9
	15		7.2	7.9	9.8	9.6	7.8	10.2
	20		8.2	8.8	11.3	8.2	7.7	9.0
	10	5.5	5.1	4.9	8.6	5.6	4.6	6.8
	15		5.4	6.1	9.0	5.5	4.7	7.9
	20		4.9	4.2	9.8	6.0	5.8	8.0
2	10	2	5.7	6.3	8.5	7.2	6.2	8.0
	15		6.6	9.2	9.3	5.4	6.6	8.9
	20		6.7	7.6	9.0	7.5	6.8	9.2
	10	5.5	4.5	4.7	6.7	5.0	5.3	7.7
	15		4.3	4.7	7.3	4.7	4.0	6.8
	20		4.7	5.1	6.4	5.1	4.8	8.0

Packaging = 0.3** | Preconditioning time = 0.3**

Storage temperature = 0.3** | Preconditioning temperature = 0.4**

Packaging x Date = 0.6** | Packaging x Storage temperature = 0.5**

Date x Storage temperature = 0.4** | Precon. temperature x Storage temperature = 0.4*

Date x Precon. temperature x Precon. time = 0.7*

Packaging x Date x Storage temperature = 0.5*

Date x Precon. temperature x Storage temperature = 0.6*

* = significant ($LSD_{0.05}$); ** = significant ($LSD_{0.001}$); n = 5

TABLE IV. Days taken to reach “eating ripeness” of unwaxed, waxed and fruit sealed in micro-perforated polypropylene bags, harvested on 03/08/04 or 23/08/04, after preconditioning and storage at 2°C or 5.5°C (30 d).

CUADRO IV. *Días adoptadas para llegar a un "comer madurez" de, encerados y frutas sellados en microperforado polipropileno bolsas, cosechadas en 03/08/04 o 23/08/04, después de haber preacondicionamiento y almacenamiento en 2°C o 5.5°C (30 d).*

Precon. time (d)	Precon. temp (°C)	Storage temp (°C)	Days taken to ripen 03/08/04			23/08/04		
			Unwax	Wax	Polybag	Unwax	Wax	Polybag
0	none	2	11.0	13.6	10.2	7.6	10.8	9.0
		5.5	5.0	5.2	6.8	6.2	7.0	6.4
1	10	2	8.2	12.4	9.6	6.4	10.0	9.0
	15		8.4	11.4	10.0	9.8	10.8	9.2
	20		9.2	12.4	12.4	7.8	10.8	8.8
	10	5.5	4.8	6.4	9.0	5.0	6.0	6.0
	15		5.2	9.6	11.0	5.0	7.4	6.8
	20		4.6	6.6	9.4	5.0	7.0	6.2
2	10	2	6.0	9.8	8.8	7.4	8.8	7.6
	15		7.2	10.0	9.8	6.0	8.6	9.6
	20		7.2	11.8	9.2	6.6	9.8	8.8
	10	5.5	4.4	6.0	7.6	4.8	7.0	7.4
	15		4.6	6.6	7.4	4.0	5.8	7.2
	20		5.4	7.4	6.6	4.4	7.0	6.6

Date = 0.3** Storage temperature = 0.3**

Packaging = 0.4** Preconditioning time = 0.4**

Preconditioning temperature = 0.4*

* = significant ($LSD_{0.05}$); ** = significant ($LSD_{0.001}$); n = 5

TABLE V. Fruit firmness of preconditioned unwaxed, waxed and fruit sealed in micro-perforated polypropylene bags, harvested on 03/08/04 or 23/08/04, immediately after storage at 2°C or 5.5°C (30 d). 100 = very hard, 0 = very soft.

CUADRO V. *Fruto firmeza de dependen, encerados y frutas sellados en microperforado polipropileno bolsas, cosechadas en 03/08/04 o 23/08/04, inmediatamente después del almacenamiento en 2°C o 5.5°C (30 d).* 100 = muy duro, 0 = muy suave.

Precon. Time (d)	Precon. Temp (°C)	Storage temp (°C)	Firmness 03/08/04 Unwax	Wax	Polybag	23/08/04 Unwax	Wax	Polybag
0	none	2	85.7	86.9	88.9	83.4	84.7	88.9
		5.5	79.5	82.9	90.0	78.3	80.7	85.4
1	10	2	85.7	87.1	88.8	83.2	85.5	88.8
	15		84.7	85.1	87.9	83.2	85.3	86.4
	20		87.2	86.4	89.6	83.2	86.3	86.3
	10	5.5	79.1	84.9	88.8	81.4	82.8	85.9
	15		80.7	83.1	86.1	78.8	81.7	85.5
	20		80.8	84.9	87.2	78.6	81.5	86.0
2	10	2	83.2	84.6	87.7	85.1	84.5	86.2
	15		82.6	83.7	87.9	85.7	84.8	86.5
	20		82.6	86.3	86.9	82.8	85.3	87.9
	10	5.5	82.4	83.7	88.3	79.6	84.2	87.7
	15		80.8	83.0	87.9	78.6	82.9	87.9
	20		81.3	81.9	87.3	78.8	82.9	87.4

Date = 0.4** | Storage temperature = 0.4**

Packaging = 0.5** | Preconditioning temperature = 0.4*

* = significant ($LSD_{0.05}$); ** = significant ($LSD_{0.001}$); n = 10

TABLE VI. Chilling injury of preconditioned unwaxed, waxed and fruit sealed in micro-perforated polypropylene bags, harvested on 03/08/04 or 23/08/04, rated immediately after storage at 2°C or 5.5°C (30 d).

CUADRO VI. *El perjuicio escalofriante de preconditioned unwaxed, enceró y la fruta cerró micro - bolsas de polipropileno perforadas, cosechado sobre 03/08/04 o 23/08/04, evaluado inmediatamente después del almacenamiento en 2°C o 5.5°C (30 d).*

Precon. time (d)	Precon. temp (°C)	Storage temp (°C)	External chilling injury rating (0..10)‡					
			03/08/04			23/08/04		
			Unwax	Wax	Polybag	Unwax	Wax	Polybag
0	none	2	1.2	1.6	0.4	1.0	2.6	0.2
		5.5	0.2	0.2	0	1.0	2.2	0.2
1	10	2	0.8	0.6	0	0.4	0.4	0.2
	15		0	0.6	0	1.6	2.6	0.2
	20		1.8	2.8	0.4	1.6	2.6	0.2
	10	5.5	0.8	0	0	0	0.4	0
	15		0	0.6	0	0	0	0
	20		0.8	1.6	0	0.2	0.2	0
2	10	2	0	0	0	0.2	0.4	0.2
	15		0.6	0.4	0	0	0.4	0
	20		1.4	3.2	0	1.8	0.8	0.2
	10	5.5	0.4	0	0	0	0	0
	15		0	0	0	0	0	0
	20		0	0	0	0	0.6	0
Date = 0.1*				Storage temperature = 0.2**				
Packaging = 0.2**				Preconditioning time = 0.2**				
Preconditioning temperature = 0.2**								
* = significant ($LSD_{0.05}$); ** = significant ($LSD_{0.001}$); n = 5								

‡ *0 = no injury, 10 = 100% surface area of fruit affected*