# CENTRAL VALLEY POSTHARVEST NEWSLETTER

**COOPERATIVE EXTENSION** **UNIVERSITY OF CALIFORNIA**
**Kearney Agricultural Center, 9240 South Riverbend Avenue, Parlier, CA 93648 • USA**

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## REDUCING 'THOMPSON SEEDLESS' TABLE GRAPE BRUISING

**Carlos H. Crisosto, Terry Rosenstengel, and F. Gordon Mitchell**

Because a high incidence of bruising has been observed in 'Thompson Seedless', we decided to look at this situation. A small test was designed to understand bruising development.

Summary of Observations (Table 1)

1. Position of the bags in the box was not related to bruising damage. The bruising damage was random in the box. This suggests that damage is not produced by the packer.

2. In general, bruised berries were located in the bottom position of the bag touching the bottom of the box. In a few cases, bruise damage occurred in other parts of the bag that were not touching the bottom of the box.

3. Crew handling during hauling was an important factor in bruising damage incidence. The gentle handling crew had an average of 29.8 bruised berries in six boxes, while the normal handling crew had an average of 67.8 bruised berries in six boxes.

4. The use of the bottom pad (BP) reduced the number of bruised berries by nearly one half (from 63.8 berries to 33.8 berries in six boxes).

5. Bruising incidence was almost double in the boxes toward the bottom of the pallet (65.3 berries) than toward the top of the pallet (32.3). This indicates that the bruising damage is associated with pallet loading.

6. Among all the treatments, grapes (gentle x top W-BP) located toward the top of the pallet had only 4 bruised berries. Grapes normally packed without a BP located toward the bottom of the pallet had 113 bruised berries.

7. The use of BP alone is not going to solve the problem.

8. A large reduction in the number of bruised berries can be achieved if a BP and gentle handling are used during pallet loading.

9. Little decay, water berries or internal browning were observed in this trial ten days after packing.

Table 1. Influence of fruit packaging and handling during the packing operation on the incidence of berry bruising of 'Thompson Seedless' grapes.

| Treatments | Number of Bruised Berries[z] |
|---|---|
| **Handling** | |
| Gentle | 29.8 |
| Normal | 67.8 |
| **Location in the pallet** | |
| Top | 32.3 |
| Bottom | 65.3 |
| With bottom pad (W-BP) | 33.8 |
| Without bottom pad (W/OUT-BP) | 63.8 |
| Gentle x top x W/OUT-BP | 32.0 |
| Gentle x bottom x W/OUT-BP | 49.0 |
| Gentle x top x W-BP | 4.0 |
| Gentle x bottom x W-BP | 34.0 |
| Normal x top x W/OUT-BP | 61.0 |
| Normal x bottom x W/OUT-BP | 113.0 |
| Normal x top x W-BP | 32.0 |
| Normal x bottom x W-BP | 65.0 |

[z] Total bruised berries in six boxes.

## TABLE GRAPE BOTTOM PAD EVALUATION

**Carlos H. Crisosto**

All of the pads tested had similar cooling rates (approximately 5 h). The static pressure across the fruit, to maintain these air-flows, was similar between the four different bottom pads. There were significant differences in the number of bruises per fruit.

Table 1. Cooling time and bruising damage for grapes packed with different bottom pads.

| Bottom pad type | 7/8 cooling time (hours)* | Static pressure (inches of water) | Bruising (%) |
|---|---|---|---|
| Control | 5.3 | 0.55 | 49 |
| Foam | 5.4 | 0.69 | 23 |
| Diaper | 5.2 | 0.50 | 19 |
| Corrugated Single Sheet | 4.8 | 0.62 | 23 |
| Excelsior Both Sides Perforated | 4.8 | 0.63 | 23 |

* Cooling time to 7/8$^{ths}$ cool downstream (hours)

## CLUSTER BAG DESIGN AND POSITION WITHIN THE BOX INFLUENCES TABLE GRAPE QUALITY

**Carlos H. Crisosto**

'Ruby Seedless' grapes were packed by using the commercial cluster bag (with ˜ 60% perforation) or the restricted cluster bag (with 1.4% perforation) in foam boxes. Five boxes (10 kg) were field packed for each treatment/evaluation date and stored at 32ºF with 90% relative humidity. Forced air cooling and initial fumigation were done at the same time. $SO_2$ penetration was measured initially and weekly during the storage period. Grapes were removed after 3, 6, and 9 weeks of cold storage for evaluation. Fruit were inoculated with a Botrytis solution before cold storage (32ºF/90%RH). Decay, stem condition (stem browning and dryness), $SO_2$ phytotoxicity, shattering incidence, and buyer opinion grade were measured on each evaluation date.

After 3 weeks of cold storage, the use of the restricted cluster bag with a 1.4% perforation reduced stem browning and increased the buyer opinion grade without affecting decay and phytotoxicity as compared to grapes stored in bags with 60% perforation (Table 1). Grapes packed in the bags with 1.4% perforation were categorized as "good" according to the buyer opinion grade.

After 6 weeks of cold storage, grapes from the bags with 1.4% perforation showed better stem condition (browning and dryness) than grapes from the control. In both treatments, decay incidence was low (Table 2).

By the 9 week storage evaluation date, stem dryness was classified as "severe" in the control (commercial cluster bag, 60% perforation) fruit, but "moderate" in the restricted cluster bag. According to the buyer opinion grade, grapes packed in the restricted cluster bag were categorized as "fair" while grapes packed in the commercial cluster bag were categorized as "poor" (Table 3).

During this trial, fruit packed in the top of the box had a higher shattering incidence than the fruit packed in the bottom of the box (Tables 1, 2, & 3). However, fruit packed with the restricted cluster bag (1.4% perforation) had less shattering than fruit packed with the commercial bag (60% perforation), 16.7% compared to 21.3%.

During the storage period, the restricted (1.4% perforation) and commercial cluster bags did not show any excessive condensation. $SO_2$ penetration was adequate in both types of cluster bags during the initial treatment and weekly fumigations. Preliminary cooling tests suggest that there is not a significant reduction in cooling time. By the last date of evaluation, a higher level of phytotoxicity

($SO_2$ damage) was detected in grapes packed with the commercial cluster bag (Table 3) than in grapes packed with the restricted cluster bag under these handling conditions.

The results indicate that the restricted cluster bag was more effective to reduce water loss and maintain stem freshness without interfering with the $SO_2$ penetration than the current cluster bag commercially used. Shatter was always higher in the top position than bottom position within the box, regardless of the type of cluster bag used.

Table 1. Quality of 'Ruby Seedless' table grapes packaged in commercial or restricted cluster bags then stored at 32ºF for 3 weeks.

| Treatment | Decay (% wt.) | Stem Condition (score 1-4)[x] | | Phytotoxicity (% wt.) | Shatter (% wt.) | Grade[y] (1-4) |
|---|---|---|---|---|---|---|
| | | Browning | Dryness | | | |
| **Bag Type** | | | | | | |
| Restricted[b] | 0.01 | 1.8 | 2.3 | 13.0 | 14.0 | 3.1 |
| Commercial[a] | 0.05 | 2.0 | 2.6 | 15.8 | 18.6 | 2.5 |
| P-value | NS | NS | 0.014 | 0.098 | 0.016 | 0.0001 |
| $LSD_{0.05}$ | NS | NS | 0.3 | 2.3 | 3.7 | 0.3 |
| **Bag Position** | | | | | | |
| Top | 0.01 | 2.0 | 2.5 | 15.8 | 20.7 | 2.7 |
| Bottom | 0.05 | 1.9 | 2.4 | 13.1 | 11.8 | 2.8 |
| P-value | NS | NS | NS | 0.103 | 0.0001 | NS |
| $LSD_{0.05}$ | 0.06 | NS | NS | 3.3 | 3.7 | NS |
| **Bag Type x Bag Position** | | | | | | |
| Restricted x Top | 0.00 | 2.0 | 2.5 | 13.2 | 19.1 | 3.0 |
| Restricted x Bottom | 0.02 | 1.6 | 2.0 | 12.8 | 11.9 | 3.2 |
| Commercial x Top | 0.03 | 1.9 | 2.5 | 18.4 | 25.4 | 2.4 |
| Commercial x Bottom | 0.08 | 2.2 | 2.8 | 13.3 | 11.7 | 2.5 |
| P-value | NS | 0.066 | 0.0087 | NS | 0.012 | NS |

[a] Commercial bag = 60% perforation
[b] Restricted bag = 1.4% perforation
[x] Stem score: 1=healthy, 2=slight, 3=moderate, 4=severe
[y] Grade: 1=poor, 2=fair, 3=good, 4=excellent

Table 2. Quality of 'Ruby Seedless' table grapes packaged in commercial or restricted cluster bags then stored at 32ºF for 6 weeks.

| Treatment | Decay (% wt.) | Stem Condition (score 1-4)[x] | | Phytotoxicity (% wt.) | Shatter (% wt.) | Grade[y] (1-4) | Shrivel[z] (1-4) |
|---|---|---|---|---|---|---|---|
| | | Browning | Dryness | | | | |
| **Bag Type** | | | | | | | |
| Restricted[b] | 0.22 | 1.5 | 3.0 | 14.5 | 14.2 | 2.3 | 3.4 |
| Commercial[a] | 0.05 | 2.3 | 3.7 | 21.1 | 19.7 | 1.4 | 2.2 |
| P-value | 0.10 | 0.0003 | 0.0001 | 0.0011 | 0.0056 | 0.0001 | 0.0001 |
| $LSD_{0.05}$ | 0.20 | 0.4 | 0.2 | 3.8 | 3.8 | 0.3 | 0.4 |
| **Bag Position** | | | | | | | |
| Top | 0.09 | 1.9 | 3.3 | 19.1 | 17.8 | 1.8 | 2.8 |
| Bottom | 0.18 | 2.0 | 3.4 | 16.6 | 16.0 | 1.8 | 2.9 |
| P-value | NS | NS | 0.054 | NS | NS | NS | NS |
| $LSD_{0.05}$ | NS | NS | 0.2 | NS | NS | NS | NS |
| **Bag Type x Bag Position** | | | | | | | |
| Restricted x Top | 0.08 | 1.4 | 3.0 | 16.1 | 16.4 | 2.3 | 3.6 |
| Restricted x Bottom | 0.36 | 1.7 | 3.0 | 12.9 | 11.9 | 2.2 | 3.6 |
| Commercial x Top | 0.10 | 2.3 | 3.5 | 22.0 | 19.1 | 1.3 | 1.9 |
| Commercial x Bottom | 0.00 | 2.3 | 3.9 | 20.2 | 20.2 | 1.5 | 2.4 |
| P-value | NS | NS | 0.054 | NS | NS | NS | 0.081 |

[a] Commercial bag = 60% perforation
[b] Restricted bag = 1.4% perforation
[x] Stem score: 1=healthy, 2=slight, 3=moderate, 4=severe
[y] Grade: 1=poor, 2=fair, 3=good, 4=excellent
[z] Shrivel: 1=severe, 2=moderate, 3=slight, 4=none

Table 3. Quality of 'Ruby Seedless' table grapes packaged in commercial or restricted cluster bags then stored at 32ºF for 9 weeks.

| Treatment | Decay (% wt.) | Stem Condition (score 1-4)[x] Browning | Stem Condition (score 1-4)[x] Dryness | Phytotoxicity (% wt.) | Shatter (% wt.) | Grade[y] (1-4) | Shrivel[z] (1-4) |
|---|---|---|---|---|---|---|---|
| Bag Type | | | | | | | |
| Restricted[b] | 0.36 | 2.6 | 3.0 | 22.0 | 16.7 | 2.4 | 1.3 |
| Commercial[a] | 0.28 | 3.1 | 4.0 | 28.9 | 21.3 | 1.2 | 2.3 |
| P-value | NS | 0.0003 | 0.0001 | 0.0017 | 0.030 | 0.0001 | 0.0001 |
| $LSD_{0.05}$ | NS | 0.3 | 0.2 | 4.2 | 4.2 | 0.3 | 0.3 |
| Bag Position | | | | | | | |
| Top | 0.38 | 2.9 | 3.6 | 27.0 | 22.0 | 1.7 | 1.9 |
| Bottom | 0.27 | 2.8 | 3.3 | 23.9 | 16.0 | 1.8 | 1.8 |
| P-value | NS | NS | 0.0037 | NS | 0.0062 | NS | NS |
| $LSD_{0.05}$ | NS | NS | 0.2 | NS | 4.2 | NS | NS |
| Bag Type x Bag Position | | | | | | | |
| Restricted x Top | 0.47 | 2.7 | 3.3 | 22.6 | 19.4 | 2.2 | 1.5 |
| Restricted x Bottom | 0.25 | 2.5 | 2.7 | 21.4 | 13.9 | 2.6 | 1.2 |
| Commercial x Top | 0.28 | 3.0 | 4.0 | 31.4 | 24.5 | 1.3 | 2.3 |
| Commercial x Bottom | 0.28 | 3.1 | 4.0 | 26.5 | 18.1 | 1.1 | 2.3 |
| P-value | NS | NS | 0.0060 | NS | NS | 0.037 | NS |

[a] Commercial bag = 60% perforation
[b] Restricted bag = 1.4% perforation
[x] Stem score: 1=healthy, 2=slight, 3=moderate, 4=severe
[y] Grade: 1=poor, 2=fair, 3=good, 4=excellent
[z] Shrivel: 1=severe, 2=moderate, 3=slight, 4=none

## FIELD BOX TEMPERATURE VARIES ACCORDING TO BOX MATERIAL

**Carlos H. Crisosto**

The influences of white and Kraft color material inside and outside the box on packed grape temperature was studied by recording temperature during field packaging. The highest packed grape temperature was recorded on boxes made with Kraft inside and outside.

Table 1. Grape temperature according to box color materials.

| Type | Temperature Measurements | | | |
|---|---|---|---|---|
| | | Hauling Delays | | |
| | Time of Packing | 1 Hr. | 2 Hr. | 3 Hr. |
| Kraft exterior & interior | 77.5ºF | 82.3ºF | 87.5ºF | 88.8ºF |
| White exterior & Kraft interior | 76.6ºF | 81.8ºF | 83.4ºF | 84.7ºF |
| Kraft exterior & white interior | 76.7ºF | 83.7ºF | 84.7ºF | 86.1ºF |
| White exterior & white interior | 77.0ºF | 81.9ºF | 83.3ºF | 83.8ºF |

## TEMPERATURE DIFFERENCES BETWEEN PLASTIC CONTAINERS WHEN PLACED IN FULL SUN

**Paul Wiley, Kearney Agricultural Center**

Reusable plastic containers for use in the produce industry have been developed by CHEP-USA and by IFCO. These containers are designed with a standardized "footprint" of 15.75 inches x 23.62 inches so that they fit a pallet 40 inches x 48 inches with no overhang.

The CHEP box is black in color while the IFCO container is a green color. While the black color may not show dirt as readily as the green color it may increase in temperature at a greater rate and with more intensity than the green (lighter) color container. In an effort to find how much difference the color makes when containers are left in the direct sun (cooling delays), containers were placed outside and temperatures were recorded using Omega temperature recorders. Temperatures were followed for a period during the days of November 15-17, 1999.

Table 1. Average Temperatures (ºF) of CHEP, and IFCO containers for 1.5 hours in full sun.

| | Nov. 15 | Nov. 16 | Nov. 17 |
|---|---|---|---|
| CHEP | 110ºF | 102ºF | 92ºF |
| IFCO | 101ºF | 93ºF | 83ºF |
| AIR | 83ºF | 74ºF | 68ºF |

In each case it appears that the CHEP (black) container averaged a 10ºF increase in temperature over that of the IFCO container when exposed to direct sun during this experiment.

## PRECONDITIONING GUIDELINES FOR KIWIFRUIT SHIPPERS

**Carlos H. Crisosto**

This protocol will deal specifically with preconditioning at shipping point. This preconditioning treatment, including ethylene exposure, is only necessary on kiwifruit that have been in cold storage for less than 4-6 weeks. Kiwifruit ripening is triggered by a cold ethylene treatment but maintaining low temperature slows softening down. As the fruit warms up at the warehouse/retailer stores, ripening will continue.

Kiwifruit should be picked according to soluble solids content (SSC). Kiwifruit must be picked to correspond with the actual minimum maturity index of at least a 6.2% soluble solids content (SSC) when inspected at the shipping point. To assure fruit quality and consumer acceptance, we recommend picking kiwifruit when it reaches at least 12.5% RSSC measured after ripening. Sensory evaluation research clearly states that SSC equal to or higher than 12.5% at consumption time assures consumer preferences.

To precondition well mature kiwifruit, 100 ppm ethylene exposure per 12 hours is recommended. A short ethylene exposure of 6 hours is enough to precondition well mature kiwifruit that have been in storage for at least one week.

## I. Preconditioning Treatment

Place cold kiwifruit in any type of container with polyliners at 32-34°F in a 40-48 ft. truck or ripening room with a temperature setting control. The types of kiwifruit containers such as tray packs, volume fill packages, or tri-wall containers with box polyliners do not interfere with the ethylene treatment. We recommend the use of polyliners to protect the kiwifruit from water loss and premature shriveling. The ripening treatment should take place far away from any packing facilities to avoid ethylene contamination during long-term storage of kiwifruit.

Ethylene applied at 100 ppm for 12 hours at 32-36°F will induce uniform kiwifruit softening and starch conversion into sugars (ripening). A 6 hour ethylene treatment is enough to precondition kiwifruit that have been in storage for more than one week. After venting, cold ethylene-treated kiwifruit can be stored back in cold storage but in a separate room away from long-term storage of kiwifruit.

Kiwifruit treated at 32°F - 34°F and maintained near 32°F may last up to 3 weeks for weak kiwifruit and up to 8 weeks for strong kiwifruit. After being transferred to higher temperatures, kiwifruit will soften according to flesh temperature (Table 1).

Table 1. Rate of kiwifruit softening after cold ethylene preconditioning treatment (32-36ºF) on cold kiwifruit.

| Temperature | Pounds Lost Per Day |
|---|---|
| 55ºF | 1.5 |
| 68ºF | 2.7 |
| 77ºF | 3.0 |

The post treatment temperature management at the receiving site should be adjusted according to the anticipated consumption schedule using Table 1. The temperature during shipping should be set near 32-36°F.

Warm kiwifruit ethylene treated at warm temperature and then cooled down to below 36°F will reach 3 lbs. within approximately six days even when held at 32°F after the treatment. We do not recommend preconditioning warm kiwifruit. We recommend preconditioning cold kiwifruit to reduce potential decay, shriveling, undesirable fast fruit softening and to maximize postharvest life.

## II. Ethylene Treatment Systems

The “Shot” and “Flow-Through” systems are the two techniques by which ethylene can be applied to kiwifruit. In either case, make sure your ripening room or truck are “well sealed”. These two ethylene application systems can be done by using compressed ethylene from a cylinder.

**The Shot System** – A measured amount of ethylene is introduced into the room. The room can be completely full. Ethylene shots from a cylinder may be applied by flow using a gauge that registers the discharge of ethylene in cubic feet per minute. The required ethylene application is made by adjusting the regulator to give the appropriate flow rate and then timing the delivery of gas. The amount of gas needed for a room is calculated by using the following information:

C = ppm of ethylene required (100 ppm)
V = volume of room in cubic feet
F = flow rate of gas (measured from flow meter) in cubic feet per minute (CFM)
T = time (in minutes) for which gas is allowed to flow

Plug this information into the following formula:

T = (C x V) / (F x 1,000,000)

For a 48-foot trailer (2,825 cubic feet), a desired ethylene concentration of 100 ppm and an ethylene flow rate of 0.018 CFM (or approximately 0.5 liters per minute), the equation would be as shown below:

(100 x 2,825) / (0.018* x 1,000,000) = 15.7 minutes

* To convert the above equation from cubic feet per minute to milliliters per minute, multiply by 28.32.

Flow time is easily measured with a stopwatch. The room should be ventilated before each application by opening the doors for at least one-half hour. In the case of kiwifruit just harvested or stored for less than a week, kiwifruit should be treated for at least 12 hours. If kiwifruit have been in cold storage for more than a week, a 6 hour ethylene treatment will trigger ripening. In both cases, a ventilation fan should be provided.

**The Flow-Through System –** With the "Flow-Through" system, ethylene is introduced into the room continuously rather than intermittently by using compressed ethylene from a cylinder or ethanol from a catalytic generator. The room can be filled to capacity with fruit. The flow of ethylene is very small and it must be regulated carefully. Regulate ethylene by reducing pressure using a two-stage regulator and passing the gas into the room through a metering valve and flowmeter. To prevent buildup of $CO_2$ or $C_2H_4$, fresh air is drawn into the ripening room at the rate which ensures a change of air every six hours (360 min.). The air should be vented through an exhaust port in the rear of the room. Fan size or Ventilation Fan Delivery, (measured in cubic feet per minute), is calculated using the following formula:

Ventilation Fan Delivery = Volume of Room (cubic feet) / 360

The ethylene flow rate (in CFM) needed to maintain 100 ppm in the room is calculated as follows:

Ethylene Flow Rate (CFM) = Ventilation Fan Delivery (CFM) x 100/1,000,000

In milliliters per minute, the flow rate is:

Ethylene Flow Rate (ml/min.) = Ventilation Fan Delivery (CFM) x 2.8

Monitoring gas in a "Flow-Through" system can be done with a "sight glass" in which ethylene bubbles through a water trap on its way to the ripening room.

### III. Ethylene Sources

Presently, there are two sources to commercially apply ethylene to kiwifruit: (1) ethylene generated from alcohol as ethylene source (catalytic) and (2) compressed ethylene from a cylinder.

**Ethylene Generator –** The ethylene generator is a machine in which a liquid (ethanol and catalyst agent) produces ethylene when heated. The generator combines a simple heater with a system for attaching a bottle of a generator liquid. Ethylene can be applied by using ethylene generators in position 1, in a "well sealed" 48 foot-trailer (2,825 cubic feet) or position 2, in a trailer not well sealed. We recommend measuring ethylene levels initially in the season for each operation.

**Ethylene Cylinder** – Use only explosion-proof mixtures. Check with your provider. Ethylene tanks require a regulator with a CGA-350 fitting. The duo stage regulator delivery pressure should not exceed 250 psi.

## IV. Safety Precautions

Mixtures of ethylene gas and air are potentially explosive when the concentration of ethylene rises above 3.1 percent by volume, which is 30,000 times greater than the concentration required to trigger kiwifruit ripening.

1. Do not permit open flames, spark-producing devices, fire, or smoking in a room containing ethylene gas or near the generator.
2. All electrical equipment, including lights, fan motors and switches, should comply with the National Electric Codes for Class 1, Group D equipment and installation.

## FUTURE EVENTS

**October 19-21, 2000**
**Intl. Conf. on Improving Postharvest Technologies of Fruits, Vegetables, and Ornamentals, Murcia, Spain.**
Contact http://www.cebas.csic.es/iirconf

**October 27-31, 2000**
PMA Convention & Expo, Anaheim, CA.

**December 6, 2000**
**UC Winter Fruit Meetings, Dinuba, CA.**
Contact Scott Johnson, 559-646-6547.

**July 8-ll, 2001**
**5th International Peach Symposium, Davis, CA.**
**Followed by optional field excursion to the San Joaquin Valley from July 12-14, 2001.**
Register online at
http://conferences@ucdavis.edu

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