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Carlos H. Crisosto
Editor

Contents

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UNDERSTANDING THE ROLE OF ETHYLENE IN THE TREE FRUIT INDUSTRY

Carlos H. Crisosto, Lluis Palou, Eric Oteiza and Giovanni Gugliuzza, Pomology Department, University of California, Davis.

The presence of ethylene during storage, transportation and retail display causes leaf and flower abscission in ornamentals, toughening of asparagus, bitterness (isocoumarin) accumulation in carrots, yellowing of cucumbers, sprouting of potatoes, and dark brown spots on lettuce. Ethylene sometimes induces the appearance of physiological disorders such as bitter pit and scald in apples and russet spot in lettuce. Acceleration of fruit ripening/softening by ethylene during cold storage and warm display is well documented. An extreme case is kiwifruit in which even a very low ethylene

concentration (20ppb) induces flesh softening, limiting long-term cold storage.

Unfortunately, there is limited information on the role of ethylene on peach, nectarine and plum postharvest performance. Early work done by Mitchell (1979) measured stone fruit softening during 4 days ripening at 68°F with and without 100ppm ethylene. Under these conditions, ethylene exposures did not speed stone fruit softening. After 4 days ripening at 68°F, ethylene treated peaches reached 1.8lbf and nectarines 2.2lbf. Untreated peaches had 2.3lbf and nectarines 2.8lbf. The only effect of ethylene on fruit softening was to reduce the standard deviation within treatments (Table 1). In plums, ethylene exposures accelerate softening. It is important to point out that very slow ripening cultivars such as 'Roysum' in addition to standard cultivars were used in this test. Mitchell did not study the role of ethylene on stone fruit performance at low temperatures (storage/shipping). However, Brencht and Kader (1982) found that treatment of nectarines with up to 500ppm ethylene during one week storage at 32°F or 50°F had no effect on the rate of color change or softening during cold storage or subsequent ripening periods at 68°F in air. In plastic wrapped nectarines, ethylene was reduced by 75% but did not affect softening (Bryan et al., 1989). In Italy, ethylene removal did not show any beneficial effect on nectarine storage potential (Tonini et al., 1989). Our preliminary work (Gugliuzza and Crisosto, 1999) on the role of ethylene on peach postharvest potential showed no benefit of ethylene exclusion at 32°F or 41°F. However, tree fruits have been classified as highly susceptible to ethylene (Cantwell, 1999). Because of this some packers/shippers/exporters are using different techniques such as potassium permanganate sachets, ventilation, catalytic oxidizers, ozone and other methods to remove ethylene during storage and/or transportation. The use of these new technologies involves an increase in the packaging costs, thus a lower return to the growers. Furthermore, the commercial benefits for tree fruit by using potassium permanganate sachets have not been demonstrated.

We believe that it is important to understand the role of ethylene on postharvest life before any commercial attempts to remove it are made. If ethylene has a role in tree fruit postharvest performance, an evaluation of different technologies to remove ethylene has to be done.

Currently, we are conducting research with the following two main objectives:

1. First, we want to understand the physiological role of ethylene during cold storage of CA-Well Mature fruit. To accomplish this, we are studying the potential role of ethylene in decay development, fruit softening, and chilling injury (internal breakdown).

2. As a second objective, we are evaluating practical ways (commercial) to remove ethylene during postharvest handling such as the use of potassium permanganate, ventilation, catalytic oxidizers, ozone and other methods.

This first report covers the evaluation of potassium permanganate sachets for ethylene removal and decay development under commercial conditions.

Materials and Methods

'Flavorcrest' peaches grown organically were collected from a commercial packinghouse (Kingsburg) immediately after packing. Eighteen trays of 30 fruit

each (one flat) were used in this experiment. Nine trays were used to determine ethylene production in the middle and corner of each tray. The other nine trays were used for inoculation. Half of the fruit in each of these trays were inoculated with *Monilinia fructicola* and the other with *Botrytis cinerea.* Inoculation with 30,000 spores/ml (20 μl per wound) was done using fresh inoculum following Dr. Adaskaveg's instructions. Decay development was evaluated as an incidence and intensity. Incidence was the number of fruit showing decay symptoms. Intensity or severity was defined as the size of the lesion.

In both cases, the trays were packaged in one of the following three ways:

1. No sachets were used.

2. One sachet containing 8 grams of potassium permanganate was placed in the center of the trays.

3. Three 8-gram sachets were used. One sachet was placed in the center of the tray and the other two were placed in the ends (Picture 1).

In all of the trays, cardboard shims the same size as the tray was placed on the top of the tray. This same experimental design was used for volume filled nectarines and plums.

After establishment of the treatments, trays were placed at 5ºC (41ºF) and 95% R.H. for a 20 day period. Ethylene production and decay development were measured on days 5, 10, 15, and 20. Ethylene was measured using a Carle model AGC-211 gas chromatograph equipped with a flame ionization detector.

Results

Ethylene Production: After 5, 10, and 15 days storage at 5ºC (41ºF), there were no significant differences in the ethylene concentrations in the packages with one sachet versus the control treatment (Table 2). Trays with three sachets had lower ethylene levels than control packages in the center of the trays on one sampling date out of three. Trays with three sachets had significantly lower ethylene levels in the ends of the trays than control trays on two sampling dates out of three. Keep in mind that only the treatment with three sachets had sachets located in the end position, thus air samples from the other two treatments were withdrawn from ends without sachets. When air samples were withdrawn from places without sachets near by, there were no differences in ethylene concentrations among treatments.

Decay Development: There were no significant differences in *Monilinia fructicola* and *Botrytis cinerea* decay incidence or severity among the three treatments on the three sampling dates (Table 3). In non-inoculated fruit, the natural infection was very low. In the three treatments (Fig. 1), *Botrytis cinerea* decay developed faster that *Monilinia fructicola* decay. After 10 days of cold storage, gray mold incidence was approximately 85% while brown rot incidence was approximately 10%. However, after 15 days, both decays reached maximum expression (100%) on inoculated fruit.

Conclusions

- Ethylene concentration in the tray was not reduced by the use of one potassium permanganate sachet per tray.

- Ethylene concentration in the tray was reduced by the use of three potassium

permanganate sachets per tray only on two sampling dates. However, decay incidence was not affected.

- Ethylene concentration in volume filled boxes was not reduced by the use of one or three potassium permanganate sachets.

- Brown rot and gray mold incidence and severity were not affected by the use of one or three potassium permanganate sachets per tray.

- Brown rot developed slower than gray mold during storage at 5ºC (41ºF). After 10 days both became very visible.

- These results do not refute the potential role of ethylene in decay development and/or postharvest life. This work only points out the lack of benefits to using potassium permanganate sachets under commercial tree fruit conditions.

- Extensive research is being developed at the F. Gordon Mitchell Laboratory to study the role of ethylene on tree fruit postharvest performance.

References

Anthony, B.R., D.J. Phillips, S. Badr, and Y. Ahroni. 1989. Decay control and quality maintenance after moist air heat treatment of individually plastic wrapped nectarines. J. Am. Soc. Hort. Sci. 114(6):946-949.

Brencht, J. K. and A. A. Kader. 1982. Ripening and reduced ethylene production by nectarine fruits following exposure to ethylene. HortScience 17:224-225.

Brencht, J.K. and A. A. Kader. 1984. Ethylene production by 'Flamekist' nectarines as influenced by exposures to ethylene and propylene. J. Am. Soc. Hort. Sci. 109:302-305.

Cantwell, Marita. 1999. UC-Davis, Postharvest Outreach Program.

Postharvest.ucdavis.edu/produce/storage/prop_np.html.

Tonini, G., S. Brigati, and D. Caccioni. 1989. CA storage of nectarines: influence of cooling delay, ethylene removal, low O_2 and hydrocooling on rots, overripening, internal breakdown and taste of fruits. Acta Horticulturae 254:335-339.

Mitchell et al., 1979. Maintaining stone fruit quality after harvest. California Tree Fruit Commission Report.

Table 1. Effect of ethylene on flesh softening of stone fruits during 4 days at 68°F (20°C).

		Flesh Firmness – lbs		
		Peach	Nectarine	Plum
Harvest	Firmness	11.6	15.3	6.1
	Std. Dev.	2.1	1.5	1.9
With 100ppm C_2H_4	Firmness	1.8	2.2	1.8
	Std. Dev.	0.4	0.6	1.0
No C_2H_4	Firmness	2.3	2.8	3.7
	Std. Dev.	1.0	1.2	2.1

Mitchell et al., 1979. Maintaining stone fruit quality after harvest. California Tree Fruit Commission Report.

Table 2. Influence of potassium permanganate sachets on ethylene concentration inside a tray of 'Flavorcrest' peaches.

Treatments Positions	Ethylene (ppm)	
	Center tray	Corner tray
Day 5		
Control (without sachet)	0.026 a	0.027 a
With 1 sachet	0.030 a	0.028 a
With 3 sachets	0.028 a	0.027 a
$LSD_{0.05}$	ND	ND
Day 10		
Control (without sachet)	0.037 a	0.039 a
With 1 sachet	0.031 ab	0.033 ab
With 3 sachets	0.028 b	0.026 b
$LSD_{0.05}$	0.0068	0.0105
Day 15		
Control (without sachet)	0.042 a	0.039 a
With 1 sachet	0.041 a	0.033 ab
With 3 sachets	0.036 a	0.026 b
$LSD_{0.05}$	ND	0.0105

Table 3. Influence of potassium permanganate sachets on decay incidence and severity of inoculated 'Flavorcrest' peaches.

Pathogen	Storage days Treat.[z]	5		10		15		20	
		Incidence[y] (%)	Intensity (mm)	Incidence (%)	Intensity (mm)	Incidence (%)	Intensity (mm)	Incidence (%)	Intensity (mm)
Botrytis	Control	0 a	0 a	93.3 a	9.3 a	97.7 a	25.9 a	100 a	62.0 a
	1 sachet	0 a	0 a	84.4 a	8.5 a	100 a	27.3 a	100 a	63.5 a
	3 sachets	0 a	0 a	80.0 a	8.1 a	100 a	25.9 a	100 a	60.2 a
$LSD_{0.05}$		-	-	ND	ND	ND	ND	ND	ND
Monilinia	Control	0 a	0 a	13.3 a	1.1 a	95.5 a	20.1 a	100 a	48.3 a
	1 sachet	0 a	0 a	0.0 a	0.0 a	100 a	18.1 a	100 a	48.5 a
	3 sachets	0 a	0 a	28.9 b	2.3 a	100 a	23.1 a	100 a	54.3 a
$LSD_{0.05}$		0	0	ND	ND	ND	ND	ND	ND

[z] For each pathogen, values within columns followed by unlike letters are different according to LSD test (p = 0.05).

[y] Incidence data were transformed to the arcsin of the square root of the proportion of infected fruits before the analysis of variance. Actual data are shown.

Fig.1. Decay development on inoculated peaches packed with and without potassium permanganate sachets. In the bottom picture, the upper two rows were inoculated with gray mold and the bottom two rows were inoculated with brown rot.

ABILITY OF THE OXTOMCAV OZONE GENERATOR TO REDUCE ETHYLENE LEVELS IN AN EXPORT CONTAINER

Carlos H. Crisosto[1], David Garner[1], Joe Smilanick[2] and Juan Pablo Zoffoli[3]

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Materials and Methods

A series of experiments were conducted at the F. Gordon Mitchell Postharvest Building at Kearney Agricultural Center to evaluate the ability of the OxtomCav ozone generator to remove ethylene from ambient air. An OxtomCav ozone generator (Model XEE-245, SN 2941) was installed in a 2,135 cu ft refrigerated Hyundai export container (ID No. DFIU-320472-1). The container was connected to a 440v power supply and the temperature set to 0ºC. The drain holes and air exchange vents in the container were closed for these trials.

Ozone was measured by circulating air from the container through an InUSA LoCon Ozone Analyzer (Model No. IN-2000-1, SN 990537; UV detector). Ethylene was measured by removing air from the ozone sample loop and then injecting the samples into a Carle gas chromatograph (Model No. AGC-211, SN 40514) equipped with a flame ionization detector.

To initiate an experiment, the empty container was vented then closed and the ozone and ethylene levels measured to determine the initial values. Ethylene was then metered into the container to establish a concentration of approximately 3.8 ppm, and then the ozone generator was turned on. Ethylene and ozone concentrations were measured hourly for a period of five hours, then again after 24 hours. The ozone generator was tested in the off position as well as levels 1, 2, 3 and 4. By way of comparison, we tested a potassium permanganate filter that is used commercially to reduce ethylene levels in export containers.

Results

Ethylene concentration within the container decreased only slightly over the test period when the ozone generator was off (35 ppb h^{-1}). This decrease in ethylene was possibly due to container leakage or ethylene degradation. The ozone generator reduced the ethylene level within the container, with the rate of reduction increasing as the generator setting was increased (Table 1). At its highest settings (levels 3 & 4), the ozone generator reduced the ethylene level in the container at a rate of 145 ppb h^{-1} as compared to 35 ppb h^{-1} for the control. The potassium permanganate filter was not as effective at reducing ethylene levels as the ozone generator (Table 1, Fig. 1). The rate of ethylene reduction for the potassium permanganate filter was similar to the control treatment.

Ozone concentrations in the container increased from the 0.0 ppm ambient level (control) to 0.2, 0.5, 1.3 and 2.1 ppm for settings 1, 2, 3 and 4, respectively, after 5 hours (Fig. 2). After 24 hours, the ozone concentration in the container reached levels of 0.3, 1.0, 3.9 ppm for settings 1, 2, and 3, respectively (Table 1). The ozone concentration exceeded the range of the analyzer (10.0+ ppm) after 24 hours with level 4. The O.S.H.A. 8 hour exposure limit for ozone is 0.1 ppm. The short-term exposure limit for ozone is 0.3 ppm. Long term exposure to concentrations above 1 ppm can cause irreparable damage and even death. For this reason it is recommended that room concentrations be monitored before entry. If high concentrations are used, a safe method of venting must be in place. More essential would be safety features designed into the

unit to monitor and control room ozone concentrations at precise ppm levels.

Conclusions

- The ozone generator was effective in reducing ethylene levels in our trials.
- Ozone monitoring and control features will be necessary to insure effective decay control, provide for human safety, and prevent fruit phytotoxicity.

Table 1. Rate of ethylene reduction and concentration of ethylene and ozone resulting from the use of an OxtomCav ozone generator in an empty 2,135 cu ft export container over a 24 hour period after introducing an initial concentration of approximately 3.8 ppm of ethylene.

Treatment	Ethylene reduction (ppb h^{-1})	Conc. after 24 hours	
		Ethylene (ppm)	Ozone (ppm)
Control	35	3.0	0.0
OxtomCav Level 1	73	2.0	0.3
OxtomCav Level 2	109	0.8	1.0
OxtomCav Level 3	145	0.2	3.9
OxtomCav Level 4	145	0.0	>10.0[z]
$KMnO_4$ filter	28	2.9	0.0

[z]Concentration exceeded the range of the analyzer.

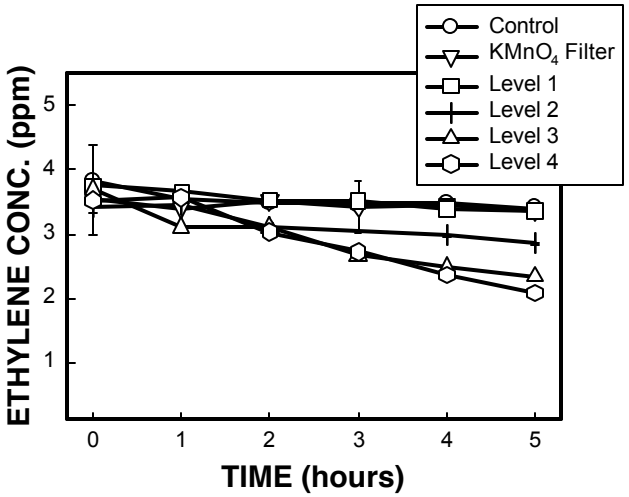

Fig. 1. Ethylene reduction resulting from the use of an OxtomCav ozone generator in an empty 2,135 cu ft export container having an initial concentration of approximately 3.8 ppm of ethylene.

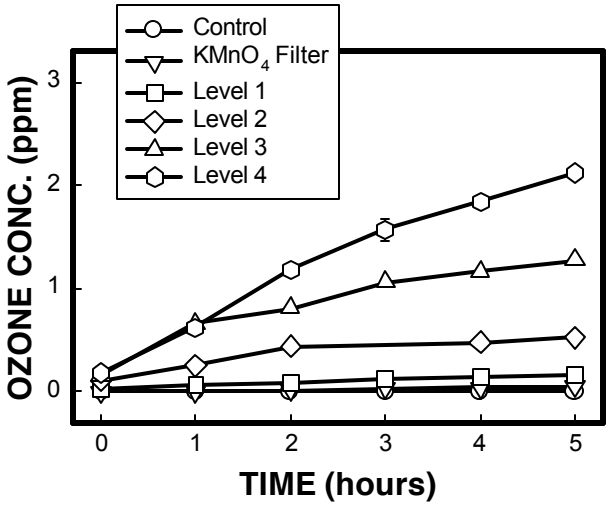

Fig. 2. Ozone concentration resulting from the use of an OxtomCav ozone generator in an empty 2,135 cu ft export container.

OPTIMUM PROCEDURES FOR RIPENING KIWIFRUIT

Carlos H. Crisosto

Most consumers prefer to purchase kiwifruit that are near ripe (“ready to eat”). To ensure good tasting, "ready to eat" fruit, kiwifruit should be ripened at any step during postharvest handling before consumer consumption. This is essential for early season, freshly harvested kiwifruit. To assure good flavor of kiwifruit when ripe, we recommend picking them when they reach at least a minimum of 6.5% SSC measured in the field or 13% SSC after the accelerated ripening test. Flesh firmness is the best indicator of kiwifruit ripening and predictor of shelf life. Fruit that measures 2-3 pounds-force flesh firmness is ripe and “ready-to-eat”.

Ripening at the Shipping Point (Ethylene pre-conditioning treatment)

Ethylene applied at 100 ppm by using the "shot system" for 12 hours within a 0 to 20°C temperature range will induce ripening

as indicated by uniform kiwifruit softening and starch conversion into sugars. Ethylene exposure can be shortened to 6 hours by using a catalytic generator (C_2H_4) or flow through application system. Ethylene pre-conditioning treatment (100 ppm for 12 hours) is only effective on freshly harvested kiwifruit or those that have been in cold storage for less than 5 weeks. Fruits kept in cold storage for longer than 5 weeks will ripen upon transfer to ripening temperatures of 59°-70°C (15-21°F) by their own ethylene.

The temperature setting during treatment and shipment should be adjusted according to the anticipated consumption schedule. To prevent softening due to delayed shipments, apply ethylene to cold kiwifruit. Cold kiwifruit treated at near 0°C and maintained at that temperature may be held up to 5 weeks. These kiwifruit will reach a firmness of about 3 pounds in 2 to 3 days after being transferred to 20°C.

Application of ethylene pre-conditioning treatment: Place kiwifruit in a ripening room with good temperature and relative humidity control. The type of kiwifruit container, such as tray pack, volume fill packages, or tri-wall containers with polyliners, does not interfere with the preconditioning treatment. The ripening room should be located far away from any packing facilities to avoid ethylene contamination of long-term storage kiwifruit. High relative humidity (90-95%) is especially recommended when ripening is carried out at temperatures higher than 7.5°C (45°F). The temperature setting during treatment and shipment should be adjusted according to the anticipated consumption schedule (Table 1).

Table 1. Rate of kiwifruit softening after ethylene treatment at 20°C (68°F).

Temperature		Days to reach a firmness of 3 lbs-force
°C	°F	
0	32	6.5 to 7.0
7.5	45	6.0 to 7.0
20	68	3.0 to 4.5

If shipping is delayed after treatment, fruit will reach a firmness of about 3 pounds-force within six days when held at 0ºC (32ºF). In this case, the temperature setting during storage and transportation should be close to 0ºC (32ºF). Cold kiwifruit treated at near 0ºC (32ºF) and maintained at that temperature may be held up to 5 weeks. These kiwifruit will reach a firmness of about 3 pounds-force in 2 to 3 days after being transferred to 20ºC (68ºF). The temperature should be set near 0ºC (32ºF) during transportation.

Ripening at the retail end

As a general rule, non-conditioned kiwifruit received in your warehouse that have been in storage less than 4 weeks or have a flesh firmness level of greater than 8 pounds should be ripened by using ethylene at warm temperature.

Pre-conditioned kiwifruit firmness must be tested upon arrival to the warehouse or retail store and handled according to its rate of softening and your rotation time. Fruit that have been in storage equal to or longer than 4 weeks or have a flesh firmness of less than 8 pounds can be ripened close to "ready to eat" by temperature management only.

In all the cases, temperature conditions for kiwifruit during storage and treatment should be adjusted according to your anticipated marketing/selling schedule. The flesh softening rate of kiwifruit is about 2.0 pounds per day when held at 20°C. Softening can be slowed down when fruit is stored at lower temperatures.

In general, kiwifruit should always be kept at temperatures below 7.5ºC (45ºF) and enclosed in liners unless they are going to be consumed within 3 days.

References

Crisosto, Carlos H. 1997. Final preconditioning guidelines for kiwifruit shippers. Central Valley Postharvest Newsletter 6(1-2):1-4.

Crisosto, Carlos H., David Garner, and Gayle M. Crisosto. 1997. Kiwifruit preconditioning protocol. Acta Horticulturae 444(2):555-559.

Ritenour, Mark A., Carlos H. Crisosto, David T. Garner, Guiwen W. Cheng, Juan Pablo Zoffoli. 1999. Temperature, length of cold storage and maturity influence the ripening rate of ethylene-preconditioned kiwifruit. Postharvest Biology and Technology 15:107-115.

Crisosto, C.H., David Garner, and Billie Shaver. 1992. Studies on kiwifruit ripening, Progress Summary Report, 1992. Report to Kiwifruit Commission, 1 p.

Crisosto, Carlos, H. 1994. Ripening guidelines for kiwifruit handlers. Report to California Kiwifruit Commission, 4 pp.

Crisosto, C.H., M.A. Ritenour, D.T. Garner, and G.U. Crisosto. 1996. Affects of maturity and postharvest factors on the ethylene requirement for kiwifruit ripening. 1995-96 Kiwifruit Report. California Kiwifruit Commission, Sacramento, CA, 20 pp.

Crisosto, Carlos H., Gayle M. Crisosto, and David Garner. 1997. Kiwifruit storage compatibility. Preliminary Report to the California Kiwifruit Commission, 1997. 5 pp.

ABSTRACTS

THE ROLE OF ETHYLENE IN DEVELOPMENT OF STORAGE DISORDERS IN NECTARINE AND PLUM

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Fruits of 'Flavortop' nectarine (*Prunus persica*) and 'Red Rosa' plum (*Prunus saliciana*) were harvested and stored for 30 and 35 days, respectively, after treatments: 1) 24 h at 20ºC; 2)100 ppb of 1-methylcyclopropene (1-MCP) for 24 h at 20ºC; 3) 15 ppm ethylene during the storage period. The results indicated that ethylene and the ethylene action inhibitor, 1-MCP, affected 'Flavortop' nectarines and 'Red Rosa' plums differently. Ethylene during storage improved the post-storage quality of the nectarines while increasing internal flesh browning in plums. The prestorage treatment with 1-MCP increased internal disorders in nectarines while plum flesh was not affected. 1-MCP inhibited firmness loss of both nectarines and plums during ripening without storage or following storage. Ethylene during storage did not affect firmness loss in nectarines post-storage while it slightly accelerated softening in plums. Exogenous ethylene

during storage gave a pronounced enhancement of ethylene production and 1-MCP a pronounced inhibition in nectarines, while plums had inhibited ethylene production from both treatments. Respiration was not affected. It is concluded that the normal ripening of 'Flavortop' nectarines is ethylene dependent. Exogenous ethylene during storage can prevent the inhibition of normal ripening which occurs in nectarines following extended cold storage and prevent storage disorders, while 1-MCP prevents the fruit from responding to ethylene and enhances storage disorders.

Red Rosa' plums do not respond favorably to ethylene and their storage disorders are not increased by blocking ethylene action with 1-MCP.

Source: 4th International Conference on Postharvest Science, Jerusalem, Israel, March 26-31, 2000.

UNDERSTANDING THE ROLE OF ETHYLENE IN PEACH COLD STORAGE LIFE

Carlos H. Crisosto, Department of Pomology, University of California, Davis, CA USA; Giovanni Gugliuzza; David Garner, and Lluis Palou, Department of Pomology, University of California, Davis, CA USA.

The influence of ethylene on fruit quality attributes, internal breakdown (mealiness, flesh browning and flesh bleeding) and decay development during long term cold storage at 0ºC and 5ºC was investigated for several peach cultivars picked at the California well mature stage. Quality attributes such as fruit flesh firmness, soluble solids concentration, titratable acidity, and flesh and ground color were not affected by continuous ethylene exposure (0, 1, 2 or 3 ppm) during long term cold storage at 0ºC and 5ºC. In 'Elegant Lady' peach, development of visual mealiness symptoms was delayed in fruit stored in 3.0 ppm ethylene compared to fruit stored under ethylene free conditions. The presence or absence of ethylene did not affect flesh browning and flesh bleeding symptoms. Free water content, a quantitative measurement of mealiness, was always higher for peaches stored in 3.0 ppm ethylene than for peaches stored in ethylene free conditions. Continuous ethylene exposure did not affect decay development, expressed as lesion size and incidence, on 'Autumn Flame' and 'Autumn Rose' peaches wound-inoculated with *Monilinia fructicola* then stored at 0ºC and 5ºC. However, *Monilinia fructicola* lesion size was larger on 'O'Henry' peaches stored in 3.0 ppm ethylene than fruit stored in ethylene free air. Decay incidence was not affected by air storage conditions. A postharvest dip in ReTain™ (aminoethoxyvinylglycine), an ethylene biosynthesis inhibitor, reduced decay development and the rate of fruit softening during cold storage. This preliminary work suggests that further studies to understand the role of ethylene during cold storage should be pursued.

Source: 4th International Conference on Postharvest Science, Jerusalem, Israel, March 26-31, 2000.

THERMAL POSTHARVEST TREATMENTS FOR IMPROVING POMEGRANATE QUALITY AND SHELF LIFE

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Sweet pomegranates, (*Punica granatum* L. cv Mollar de Elche) were cold-stored for 90 days. Curing at 33ºC and 95% RH for 3 days before continuous storage at 2 or 5ºC and 95% RH was tested for reducing chilling injuries. Alternatively, cycles of intermittent warming (IW) of 1 day at 20ºC every 6 days at 2 or 5ºC were tested. Control fruits were conventionally stored at 2 or 5ºC and 95% RH, and a shelf life of 6 days at 15ºC and 75% RH was included in the trials. At the end of the storage and shelf life periods, IW fruits showed the highest anthocyanin concentrations and titratable acidity, and the best visual appearance. After shelf life, IW during 2ºC storage was the only treatment that resulted in fruit with flavor similar to that at harvest. Main losses were due to decay (*Penicillium* spp.) in treatments at 5ºC, with the least loss being in the IW2ºC treatment. Chilling injuries (pitting and husk scald) were strongly reduced by curing at 2ºC but only after cold storage. The lowest chilling injuries were found in the IW treatments. Severity of husk scald development was not directly related to low storage temperature. IW during 2ºC storage has proved to be the best treatment for minimizing chilling injuries and maintaining pomegranate fruit quality.

FUTURE EVENTS

June 10-13, 2000
CLFP World Congress on the Processing Tomato, Sacramento, CA.

June 20, 2000
Pomology KAC Field Day, Parlier, CA.
Contact Scott Johnson, (559) 646-6547

July 25, 2000
Pomology KAC Field Day, Parlier, CA.
Contact Scott Johnson, (559) 646-6547

August 22, 2000
Pomology KAC Field Day, Parlier, CA.
Contact Scott Johnson, (559) 646-6547

September 2000
AgTech 2000, Food Quality and Safety, UC Davis.

September 12-15, 2000
6th Annual Fresh-Cut Workshop, UC Davis.
Contact Marita Cantwell or Sharon Munowitch, University Extension, (800) 752-0881, Fax (530) 757-3558, e-mail smunowit@unexmail.ucdavis.edu

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.

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