8. Castro-Garcia S, Rosa UA, Gliever CJ, Smith D, Burns JK, Krueger WH, Ferguson L, Glozer K (2009) Evaluation of table olive damage during harvest with a canopy shake-and-catch system. HortTech 19:260-266.

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IFAS Citrus Initiative MH Annual Progress Report 2010-11

Investigator:

PI – M.D. Danyluk
Co-PIs – T.M. Spann, J.K. Burns

Objective(s) Pursued (Priority Topics):

Objective 1: Evaluate standard juice quality and yield following the application of CMNP application trials for Hamlin and Valencia varieties and storage of up to 7 days.

Detailed Accomplishments in 2010-11:

This study evaluates the standard juice quality and yield of fruit harvested following the application of CMNP and stored for up to 7 days to determine if CMNP application has any effect on these parameters. For each replicate (one Hamlin and two Valencia), harvested fruit will be collected. Fruit were then be divided into treatment groups and stored for up to 7 days. Treatments groups will included storage at: 10, 20, 30°C and ambient conditions (with temperature and humidity monitors). Within each group of fruit, 5 non-defective fruit will be randomly selected from each group at each sample point for analysis. Quality analysis, still underway and not reported here include °Brix, Acid, % oil, and color.

To enumerate microorganisms, 30 ml of buffer were added and the rub/shake/rub technique was sued to remove microorganisms from the fruit surface. Microbial analysis included total aerobic plate count (APC) on plate count agar (PCA), and acidophilic organisms count (AOC) on orange serum agar (OSA). Results of trials completed are reported in Tables 1 (January, 2011 Hamlin), 2 (April, 2011 Valencia) and 3 (May 2011 Valencia) as colony forming units (CFU) per orange. In general, no differences were seen in total APC or AOC microflora on orange surfaces with or without CMPN application during storage at any temperature.

Alicyclobacillus testing was be done by heat shocking the remaining fruit wash described above for 10 min at 85° then plating onto Ali Agar (AA). No *Alicyclobacillus* was identified from any of the samples.

Table 1. Fruit surface microflora in log colony forming units (CFU) per orange one trial of Hamlin fruit harvested in January with or without CMNP application (n = 5 oranges) during storage of up to 7 days at 10, 20, 30°C or under ambient conditions.

		Control		CMNP	
Temp (°C)	Time (day)	APC	AOC	APC	AOC
	0	4.6 ± 0.3	4.9 ± 0.2	5.0 ± 0.6	5.1 ± 0.3
10	3	4.5 ± 0.2	5.0 ± 0.2	4.6 ± 0.5	4.6 ± 0.4
	5	5.1 ± 0.2	4.9 ± 0.2	5.5 ± 0.2	5.2 ± 0.4
	7	5.1 ± 0.2	5.3 ± 0.1	5.0 ± 0.3	5.3 ± 0.2
20	3	4.7 ± 0.2	4.7 ± 0.2	4.7 ± 0.4	4.7 ± 0.3
	5	5.2 ± 0.4	5.0 ± 0.3	5.4 ± 0.5	4.9 ± 0.3
	7	5.1 ± 0.2	5.3 ± 0.1	5.1 ± 0.4	5.3 ± 0.1

30	3	4.6 ± 0.4	4.5 ± 0.4	4.9 ± 0.3	4.7 ± 0.3
	5	5.0 ± 0.6	5.0 ± 0.4	5.3 ± 0.3	4.7 ± 0.1
	7	5.2 ± 0.1	5.1 ± 0.1	5.8 ± 0.5	5.5 ± 0.4
Ambient	3	4.8 ± 0.2	4.8 ± 0.2	4.7 ± 0.6	4.7 ± 0.4
	5	5.1 ± 0.4	4.9 ± 0.2	5.3 ± 0.3	4.7 ± 0.1
	7	5.1 ± 0.5	5.2 ± 0.1	5.2 ± 0.3	5.2 ± 0.1

Table 2. Fruit surface microflora in log colony forming units (CFU) per orange one trial of Valencia fruit harvested in April with or without CMNP application (n = 5 oranges). during storage of up to 7 days at 10, 20, 30°C or under ambient conditions

		Control		CMNP	
Temp (°C)	Time (day)	APC	AOC	APC	AOC
	0	5.3 ± 0.3	5.2 ± 0.3	5.2 ± 0.2	5.1 ± 0.2
10	3	5.1 ± 0.1	5.1 ± 0.1	5.4 ± 0.1	5.2 ± 0.1
	5	5.5 ± 0.1	5.2 ± 0.1	5.2 ± 0.3	4.9 ± 0.2
	7	5.1 ± 0.3	5.3 ± 0.2	4.9 ± 0.1	5.4 ± 0.2
20	3	5.1 ± 0.1	5.0 ± 0.3	5.4 ± 0.1	5.3 ± 0.3
	5	5.3 ± 0.1	5.3 ± 0.2	5.4 ± 0.2	5.3 ± 0.2
	7	4.9 ± 0.1	5.2 ± 0.2	4.9 ± 0.1	5.3 ± 0.1
30	3	5.2 ± 0.2	5.4 ± 0.2	5.5 ± 0.4	5.2 ± 0.4
	5	5.4 ± 0.1	5.2 ± 0.2	5.5 ± 0.2	5.3 ± 0.2
	7	5.2 ± 0.1	5.0 ± 0.2	5.2 ± 0.1	5.0 ± 0.1
Ambient	3	5.0 ± 0.1	5.0 ± 0.2	5.0 ± 0.1	5.2 ± 0.3
	5	5.2 ± 0.2	5.2 ± 0.2	5.5 ± 0.4	5.3 ± 0.4
	7	5.0 ± 0.3	5.1 ± 0.0	5.2 ± 0.1	5.1 ± 0.1

Table 3. Fruit surface microflora in log colony forming units (CFU) per orange one trial of Valencia fruit harvested in May with or without CMNP application (n = 5 oranges) during storage of up to 7 days at 10, 20, 30°C or under ambient conditions.

		Control		CMNP	
Temp (°C)	Time (day)	APC	AOC	APC	AOC
	0	5.1 ± 0.3	5.2 ± 0.3	5.0 ± 0.2	5.1 ± 0.1
10	3	5.5 ± 0.2	5.4 ± 0.4	5.4 ± 0.1	4.9 ± 0.3
	5	5.4 ± 0.1	5.3 ± 0.1	5.5 ± 0.1	5.4 ± 0.4
	7	5.2 ± 0.2	5.3 ± 0.3	5.2 ± 0.4	5.1 ± 0.4
20	3	5.3 ± 0.1	5.3 ± 0.4	5.3 ± 0.1	5.2 ± 0.4
	5	5.5 ± 0.1	5.4 ± 0.1	5.4 ± 0.1	5.4 ± 0.1
	7	5.4 ± 0.3	5.2 ± 0.3	5.5 ± 0.1	5.3 ± 0.2
30	3	5.2 ± 0.2	4.9 ± 0.4	5.3 ± 0.1	5.0 ± 0.2
	5	5.5 ± 0.1	5.5 ± 0.1	5.4± 0.1	5.4 ± 0.1
	7	5.2 ± 0.3	5.1 ± 0.3	5.0 ± 0.4	5.1 ± 0.4
Ambient	3	5.1 ± 0.3	5.2 ± 0.3	5.3 ± 0.1	4.9 ± 0.1
	5	5.4 ± 0.1	5.4 ± 0.2	5.5 ± 0.1	5.4 ± 0.1
	7	5.2 ± 0.4	5.2 ± 0.2	5.2 ± 0.3	5.2 ± 0.2

Areas where progress exceeded expectations:

In addition to simply testing for *Alicyclobacillus presence*, APC of all microorganisms and AOC counts were obtained.

Areas where progress didn't meet expectations:

Originally we had planned to collect fruit from large CMNP harvest trials run by Eble. Unfortunately for this project, these harvest trials were all pushed into May and April of 2011. Thus, small scale trials run on trees at CREC were used instead.

Impact of accomplishments towards overall goals of funding:

There is practical importance to the surface microflora of oranges delivered to the processor. Contamination of raw materials is listed as the second most serious food safety problem in the food processing industry, after deficiencies in employee training. However, incoming fruit to citrus processing plants is typically washed and sanitized, and the vast majority (>98%) of Florida-processed orange juice is pasteurized or similarly treated to inactivate spoilage enzymes and to microbiologically stabilize the product. Wider adoption of mechanical harvest/pick up systems will be somewhat determined by the quality of fruit delivered to the processor. This quality includes potential microbiological contamination as well as the typical measures of machine yield and efficiency, and economics. For these reasons, it is important to collect fruit and juice microbiological quality information for any harvest/collection system that promises commercial viability.

Presentations associated with 2010-11 efforts:

Results will be presented at the 2011 Florida State Horticultural Society.

Publications from 2010-11 efforts:

Refereed:

Spann, T.M. and Danyluk, M.D. 2010. Mechanical harvesting increases leaf and stem debris in loads of mechanically harvested citrus fruit. HortSci. 45:1297-1300.

Non-refereed:

A paper will appear in the 2011 FSHS Proceedings

Next steps:

Objectives for the 2010/2011 season will involve continuing to evaluate CMNP applications to fruit, and we will target two Hamlin and two Valencia trials. Additionally, experiments to determine the fate of indicator organisms on fruit will begin.

IFAS Citrus Initiative MH Annual Progress Report 2010-11

Evaluation of CMNP Formulations and the Effects of CMNP on Fruit Peel Integrity and Fruit Storability

Investigator:

PI – Timothy M. Spann
Co-PIs – Michelle D. Danyluk

Objective(s) Pursued (Priority Topics):

1. Determine the effects of CMNP application on peel integrity, fruit storability, and post processing peel quality.

2. Determine the effects of various spray residues and tank mixtures on the efficacy of CMNP

Detailed Accomplishments in 2010-11:
CMNP effects on peel quality: To determine whether the peel scaring sometimes caused by CMNP application reduces peel integrity and increases losses due to fruit crushing and/or decay prior to processing data were collected from one 'Hamlin' and two 'Valencia' orange harvests (January, April, May 2011). Fruit were treated with CMNP at 300 ppm a.i. in a spray volume of 300 gal/acre using a hand-gun sprayer. Fruit were harvested by hand from 5 CMNP-treated and 5 untreated control trees 4 days after CMNP application. Both treated and non-treated fruit were stored at ambient temperature, 10, 20 and 30 C for 7 days. At 0, 3, 5 and 7 days after harvest decay was recorded and fruit were tested for peel puncture force and fruit crush force. There was a strong interaction between temperature and fruit decay. CMNP treated fruit decayed more quickly than untreated fruit at all temperatures, and decay increased with temperature regardless of CMNP treatment. However, fruit decay was minimal for all treatments and storage temperatures through 3 days after harvest, indicating that during the normal harvest to process window there are no significant effects of CMNP treatment on fruit decay. Peel puncture force and fruit crush force were unaffected by CMNP treatment. Peel puncture force and fruit crush force both decreased steadily from 0 to 7 days after harvest and the decrease was temperature dependent, occurring more quickly at higher temperatures.

Spray residue effects on CMNP efficacy: One study investigating the effect of various spray residues on CMNP efficacy was completed on 'Hamlin' fruit in late January 2011. Two similar trials are planned for 'Valencia' fruit in May (underway) and June 2011. Residues of a foliar nutrition mixture and kaolin clay were applied to selected branches using a handgun-type sprayer. Fruit on other branches were individually coated with a postharvest wax. Fruit with no residue or wax served as controls. CMNP was applied 3 days after residue or wax application at 300 ppm a.i. at 300 gal/acre using a handgun-type sprayer. In addition, a CMNP and foliar nutrition mixture tank mix was also applied to fruit with no prior spray residue application. Fruit detachment force (FDF) data collected 72 and 96 hours after CMNP application showed that all residues reduced the efficacy of CMNP relative to fruit with no residue. Tank mixing CMNP had no effect on efficacy. Although the residue treatments reduced CMNP efficacy (measured as FDF), the reduction in FDF achieved in all treatments was >50% compared to non-CMNP treated fruit. This is important since a 50% reduction in FDF is the target reduction for use with mechanical harvesting systems.

Areas where progress exceeded expectations:
The data on peel integrity were extremely consistent across the trials and validate the earlier data collected in 2009-2010, indicating very clearly that the peel blemishes associated with CMNP application are not detrimental to fruit harvested for processing when it is processed within the normal time window.

Areas where progress didn't meet expectations:
Due to uncertainties in the planning of large scale CMNP trials during the 2010-2011 season we did not collect peel quality and storage data from early season 'Hamlin' fruit.

Impact of accomplishments towards overall goals of funding:
This research has a significant impact towards the overall goals of the program. A continuing concern from growers and processors as CMNP has been developed is tree health and fruit quality. These data directly address concerns about fruit quality and clearly indicate that there is no need for concern when applications are made according to recommendations and the normal

harvesting/processing routine is followed. In addition, the data indicate that residues from spray applications made at least 3 days prior to CMNP application should not have affect the overall use of CMNP in the abscission/mechanical harvesting system.

Presentations associated with 2009-10 efforts:
Spann, T.M. Citrus Mechanical Harvesting Research Advisory Council Meeting, Bartow, 1 March 2011.

Pozo, L. I. Kostenyuk, J.K. Burns and T.M. Spann. International Society for Horticultural Sciences Congress, Lisbon, Portugal, August 2010.

Publications from 2009-10 efforts:
Spann, T. M., L. V. Pozo, I. Kostenyuk and J. K. Burns. 2011. Application of the abscission agent 5-chloro-3-methyl-4-nitro-1*H*-pyrazole does not affect peel integrity or postharvest decay of mechanically harvested late-season 'Valencia' orange fruit during the normal commercial harvest-to-processing period. HortScience *accepted*.

Next steps:
We will complete the 'Valencia' spray residue efficacy trials and analyze the data. Based on the final data analysis further experiments will be designed if warranted; however, we do not anticipate additional work occurring in this area.

We will complete additional early season 'Hamlin' studies on peel quality and storage during the 2011-2012 harvest season and verify the late season 'Hamlin' and all 'Valencia' data by repeating those trials during 2011-2012.

IFAS Citrus Initiative MH Annual Progress Report 2010-11

Investigator:

PI – J.P. Syvertsen, J.C. Melgar (postdoc) & A. Kusakabe (MS grad student)
Co-PIs –J.K. Burns, T.M. Spann, K. Morgan, R. Ebel and F.M. Roka

1. Objectives Pursued: Priority Topics—**Horticultural Concerns, Tree Health**
Objective 1. Develop methods that extend the mechanical harvesting window by delay of flowering. H_o: Delaying bloom with drought stress in winter in 'Valencia' can improve late season harvesting in 'Valencia'. If bloom can be delayed 3 weeks, younger fruitlets should be smaller and less susceptible to late season mechanical harvesting losses during May and June.
Objective 2. Study physiological mechanisms of drought stress and interactions with mechanical harvesting. Reduce injuries to trees and fruit. H_o: Partially broken branches not only experience drought stress, but also have decreases in photosynthesis, accumulation of carbohydrates and develop leaf symptoms that also can be confused with mineral deficiencies or greening.
Objective 3. Determine interactions with mechanical harvesting, drought stress and ABA in citrus trees on different rootstocks.
Progress on Objectives:
Detailed Accomplishments in 2010-11: **Objective 1.**
--Mechanical vs. hand harvesting were compared during three consecutive years (2007-2009) with and without three winter time (Dec-March) drought treatments to determine any possible carry over effects.