

Guarantee®

Seaweed Extract

Enhances Fruit Quality in Honeycrisp Apples

Ocean Organics *Guarantee*® Seaweed Extract Enhanced these Quality Measurements:

- **Statistically increased fruit coloration (redness)**
- **Statistically increased peel surface blush**
- **Statistically increased flesh firmness**
- **Increased proportion of larger fruit**
- **Lessened soft scald**
- **Lessened soggy breakdown**

Early to Market...

“Guarantee increased peel coloration and quantity of the blush, particularly with Harvest 1, when color is normally less than ideal.”

– University of Maine, final report

CROP

Honeycrisp apples

STUDY OBJECTIVES

- To evaluate an Ocean Organics seaweed extract program on fruit quality in Honeycrisp apples
- To measure impact on fruit color, size, firmness, BRIX, bitter pit development and storage disorders

LOCATION/SCIENTISTS

University of Maine Highmoor Farm, Monmouth, ME

Investigator: Renae Moran, Ph.D.

Study Directors: Mike Roberts and George Seaver, Ocean Organics

Based on report provided by Dr. Renae Moran and Greg Koller



Untreated apples (Harvest 1)



Apples treated with Guarantee had statistically increased redness and blush.

STUDY DESIGN

Researchers at University of Maine applied **Guarantee** Seaweed Extract at a rate of 1 qt/acre (in 60 gal of water) four times during the 2017 growing season: June 9, June 24, July 16 and August 7. Three separate Honeycrisp orchards with two sections in each were treated. One section in one orchard was non-uniform for crop load, vigor and fruit quality, and was eliminated from the study. Each of the remaining five orchards was representative of commercial orchards in the region with respect to rootstock, tree care, pest management, fertility, crop load and fruit quality. Leaf analysis was measured on 50 leaves from each orchard and treatment.

Trees were harvested three times to encompass the normal harvest period for this variety:

- Harvest 1 – Sept. 14, 15 and 16
- Harvest 2 – Sept. 27, 28 and 29
- Harvest 3 – Oct. 7, 10 and 12

One bushel (50 to 80 fruits) was harvested from each of the two treatments and from each section

of the three orchards. The percentage of peel surface colored pink or red was visually estimated on every fruit. It became apparent during the first harvest that **Guarantee** was increasing the quality of the blush as well, so this was measured on every fruit during harvests 2 and 3 as the degree of redness from none (redness = 0) to dark red (redness = 4). We completed this measurement on fruit from Harvest 1 after storage. Fruit weight was weighed on every fruit at harvest and after storage.

Fruit ripeness as starch index, and quality as soluble solids (Brix) and flesh firmness were measured on a subset of 10 fruit at harvest. Delta Absorbance (DA) of peel chlorophyll was measured on two sides of every fruit as an indicator of ripeness. A subset of fruit was diced and frozen for subsequent nutrient analysis in March. Quality was measured after storage when chilling injury disorders were not severe. Fruit were placed in cold storage at 34°F until Feb. when chilling injury and bitter pit were measured as the number of fruit with each disorder.

RESULTS

Based on report provided by Dr. Renae Moran and Greg Koller

Fruit Coloration and Blush

The quality of color (pink versus red) in fruit from all harvests is shown in Figure 1 and Table 1. **Guarantee** statistically increased peel coloration (Redness rating) in fruit from Harvest 1 and 2 compared to untreated fruit. This is especially relevant with Harvest 1, when fruit color is normally less than ideal. The redness rating was numerically higher in treated fruit in Harvest 3.

As can be seen in Figure 1 and Table 1, treatment with **Guarantee** statistically increased the quantity of the blush (Peel color %) in Harvest 1 compared to untreated fruit. Although the data were not statistically significant in Harvest 2 and 3, there was a numerical trend towards treated fruit having higher quantity of blush (Peel color %) in Harvest 2 and 3.

Flesh Firmness, Brix

As shown in Table 1, flesh firmness was increased by **Guarantee** Seaweed Extract in fruit from Harvest 1, but not Harvest 2 or 3. Soluble solids (Brix) were increased slightly, but only during Harvest 2.

Figure 1: Percentage of fruit peel with red coloration with and without Guarantee Seaweed Extract. Seaweed extract applied four times in summer increased fruit coloration ($P = 0.0180$) and the darkness of the blush. A redness rating of 1 indicates a color of pink and a rating of 3 indicates red. The increase in color was most effective in fruit from the first harvest when color is typically poor. The increase in color was diminished by the third harvest. Seaweed extract decreased the proportion of fruit with poor color and increased the proportion with good color. Fruit with good color had at least 50% of the surface colored red.

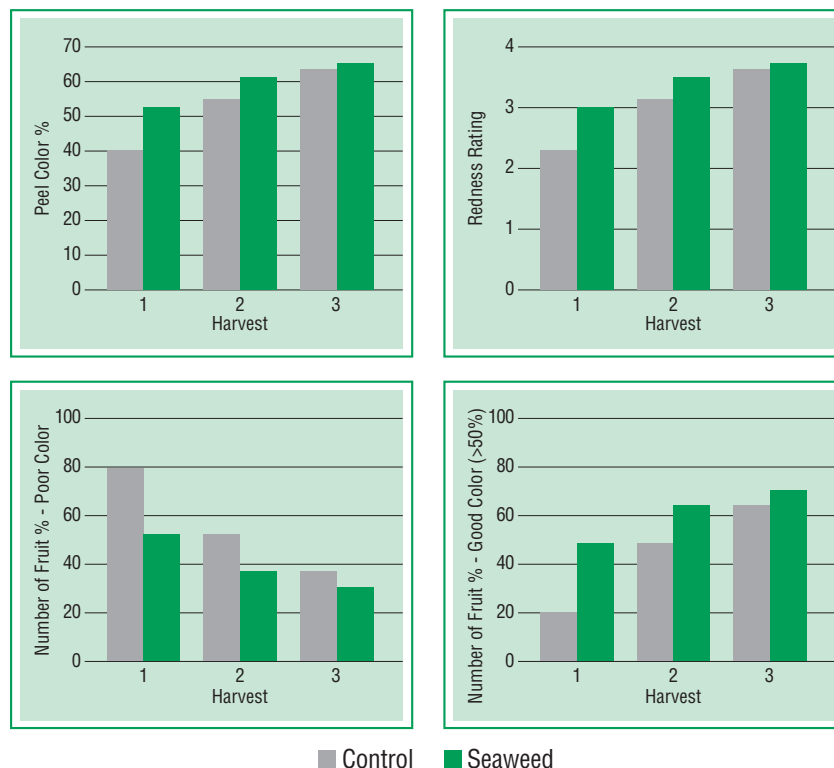


Table 1: Fruit maturity (ripeness) and quality at harvest in fruit with and without prior application of Guarantee.
* indicates a significant effect of Guarantee.

Harvest	Treatment	DA Units	Starch Index (1-9)	Soluble Solids (%)	Flesh Firmness (lbs)	Peel Surface blush (%)	Redness (0-4)	Fruit Weight (oz.)
All	Untreated	0.90	--	12.1	14.1	53	2.4	7.8
	Treated	0.80	--	12.2	14.2	60*	2.7*	8.0
1	Untreated	1.23	5.8	12.0	15.2	40	1.7	7.0
	Treated	1.11	5.5	12.1	16.0*	52*	1.9	7.5
2	Untreated	0.82	7.7	12.0	14.1	54	2.3	7.8
	Treated	0.76	7.6	12.5*	14.1	62	2.6*	8.2
3	Untreated	0.57	7.9	12.2	13.3	64	2.5	8.4
	Treated	0.53	8.0	12.0	13.1	66	2.8	8.4
Analysis of Variance								
Harvest		0.0001	0.0001	0.3170	0.0001	0.0001	0.0122	0.0001
Treatment		0.2183	0.2922	0.2468	0.0898	0.0180	0.0089	0.0823
Interaction		0.2095	0.5707	0.0343	0.0137	0.3191	0.7246	0.5662

DA units greater than 0.6 may indicate greater risk of bitter pit, and less than 0.4 may indicate over-ripeness for long-term storage.

Starch index is typically 5 or greater for harvest of Honeycrisp. A low starch index indicates greater starch and less ripe.

Analysis of Variance values of less than 0.05 indicate a significant effect of either harvest date, Guarantee or their interaction (i.e. the effect of Guarantee is not the same in every harvest).

Redness rating 1 = pink, 2 = light red, 3 = red, and 4 = dark red.



Untreated apples (Harvest 2)

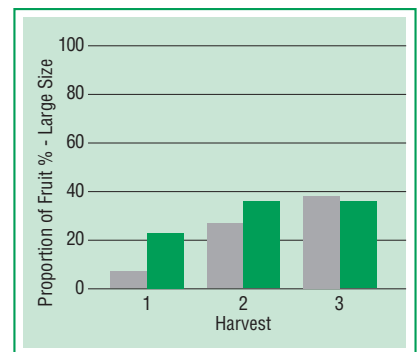
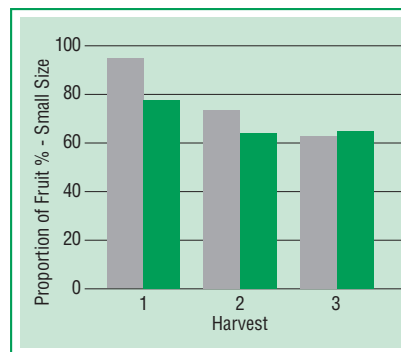
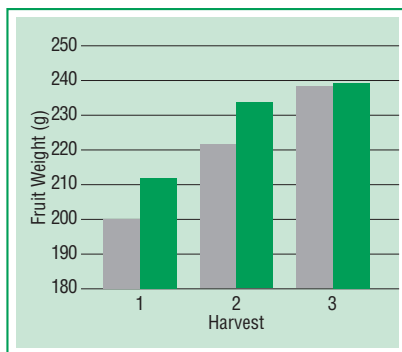


Apples treated with Guarantee had statistically increased redness and blush.

Fruit Weight

Guarantee did not statistically increase fruit size, as indicated by average fruit weight, but **increased the proportion of larger fruit** (greater than 9 oz.).

Figure 2: Average individual fruit weight with and without *Guarantee*. Seaweed extract did not significantly increase the average fruit size ($P = 0.0823$). However, the proportion of small fruit (less than 9 oz.) was decreased and the proportion of large fruit (greater than 9 oz.) was increased by *Guarantee* Seaweed Extract ($P = 0.022$), particularly with fruit harvested first. The effect was diminished in the third harvest.



■ Control ■ Seaweed

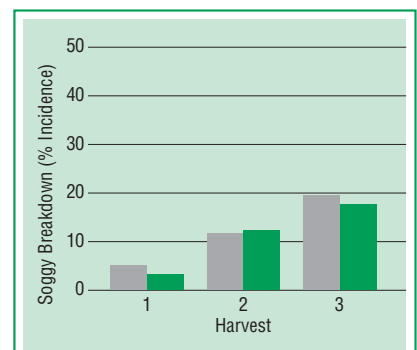
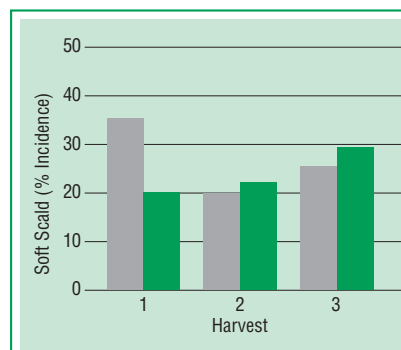
Storage Disorders (Bitter Pit, Soft Scald, and Soggy Breakdown)

Honeycrisp apples are highly prone to the development of storage disorders. Soft scald and soggy breakdown are two chilling injury disorders (note that fruit were stored at 33°F to induce chilling injury, which is not how the industry stores this variety).

As can be seen in Figure 2, there was less soft scald in treated fruit from Harvest 1 (roughly 20% compared to over 30%). There was numerically less soggy breakdown in treated fruit from Harvest 1 and 3.

Guarantee had no effect on the number of fruit that developed bitter pit, but bitter pit was not prevalent this year.

Figure 3: *Guarantee* significantly reduced the occurrence of soft scald in fruit from the first harvest. *Guarantee* had no statistically significant effect on incidence of soggy breakdown, but there was a numerical decrease in Harvest 1 and 3. Honeycrisp apples were cold stored for 4 months to test for storage disorders.



■ Control ■ Seaweed

RESULTS continued

Potassium Levels

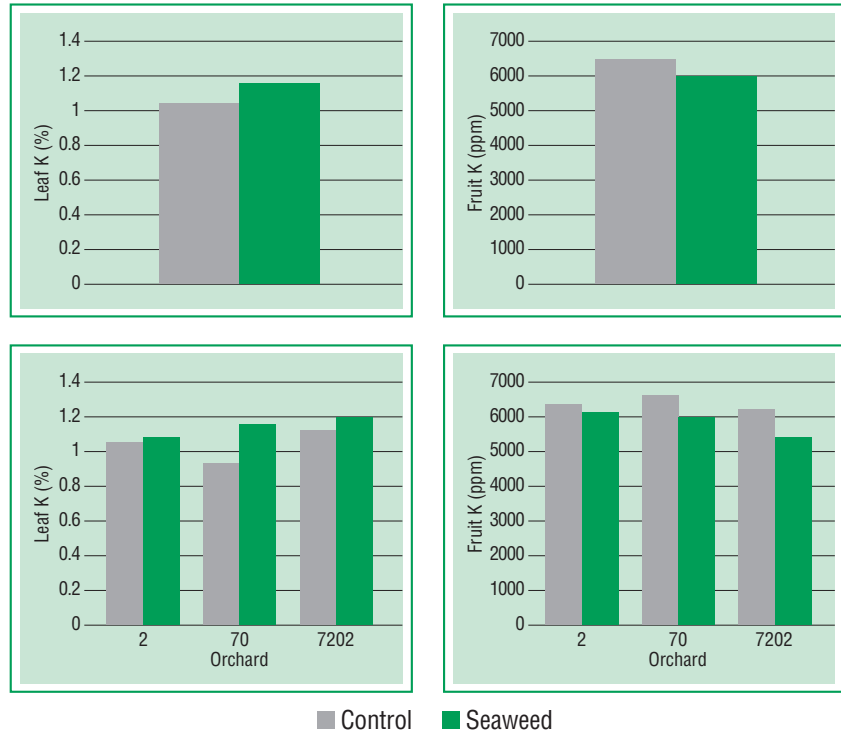
Foliar analysis indicated that **Guarantee** raised foliar levels of potassium, but this effect was not highly significant. Fruit calcium and potassium, on a dry weight basis, were not affected by **Guarantee**, but when fruit size is larger, a dilution effect may occur.

CONCLUSIONS

Guarantee:

- statistically increased fruit coloration (both redness and blush). This is especially relevant with Harvest 1, when fruit color is normally less than ideal
- Increased the proportion of larger fruit
- Significantly lessened soft scald in the first harvest
- Showed trend of less soggy breakdown in the first and last harvest
- Statistically increased flesh firmness

Figure 4: Foliar and fruit potassium concentration on a dry weight basis in Honeycrisp leaves collected in July and fruit during the first harvest. Guarantee Seaweed Extract applied four times in summer increased leaf potassium in two of three orchards ($P = 0.067$), but did not increase fruit potassium.



Untreated apples (Harvest 3)



Apples treated with Guarantee had statistically increased redness and blush.

Ocean Organics has been processing seaweed and formulating fertilizers for over 40 years. Our innovative processing technology yields products richer than others yet with fewer solids and lower viscosity. This means our extracts can be used with a broader range of materials with better blending, mixing and stability characteristics. Our seaweed-based fertilizers, plant health materials and soil conditioners lead the industry in quality, effectiveness, cost efficiency and environmental sustainability.



Ocean Organics®

Manufacturing

Waldoboro, Maine • 888-312-0106

Administration

Ann Arbor, Michigan • 800-628-GROW (4769)
oceanorganics.com