harvesting

CHEMICAL AND AIR SHAKER ORANGE EMOVAL IN SOUTH FLORIDA (LaBELLE)

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Abstract. A series of harvesting experiments was conducted under commercial conditions with oranges (**Citrus sinensis** Osbeck, cv Hamlin). Trees were on eight-row beds with no water furrow. Abscission sprays were applied with air carrier sprayers

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and trees were shaken with an experimental air shaker using a conical scanning air delivery system at a harvest rate of 1.5 acres (0.6 ha) per hour. Fruit removal percentages ranged from 97 to 99. Uniform spray coverage was necessary to achieve these high recovery rates. The most effective chemical combination was Release (100 ppm) and Acti-Aid (1.5-2.5 ppm). The low Acti-Aid concentrations improved fruit loosening with minimal leaf losses. The number of degree-hours above 60°F (16°C) for January-February, 1979 was computed to be 19 per cent and 40.6 per cent greater than for comparable groves near Lake Alfred (central Florida) and Tavares (north-central Florida), respectively. These higher temperatures could be the principle reason that the fruit removal effort was more successful in the south Florida area. The estimated total cost of removing the fruit to the ground was $0.41/box (40.8 kg).

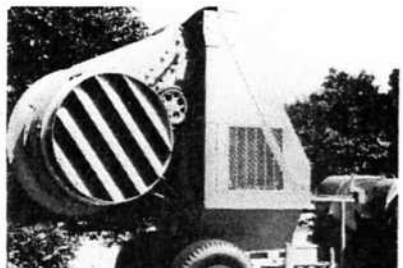

Figure 1. Air harvester developed by FDOC utilizing conical scanning air delivery system.

Over the past 20 years, many harvesting experiments, with or without abscission (loosening) chemicals, have been conducted under field conditions. In general, results of most of these tests with early and midseason oranges (E-MS) have concluded that limb shakers, with or without catching frames, are suitable for most Florida citrus trees which are sufficiently open (or can be opened by light pruning) to allow attachment of the tree clamps (1).

Abscission chemicals are not necessarily needed for these systems. However, their use is beneficial as an aid to speed fruit removal, increase removal efficiency and lessen power requirements necessary to shake a tree. Since chemical loosening is not always effective, its use has not allowed development of less powerful and expensive shaking equipment.

The citrus industry is interested in the air shaker method of fruit removal because its high removal rate (capacity) holds removal cost per box of harvested fruit to a minimum. Machine repairs are inherently less as the shaking power is distributed constantly to the tree through the air delivery system without reaction vibrations transmitted into the machine.

The problem of adopting the air shaker approach to fruit removal for E-MS oranges has been 1) erratic abscission chemical behavior, which seems to be principally due to adverse

weather effects during the Winter months, and 2) application of abscission chemicals requires uniform fruit coverage for air harvester operations, as the mode of action of these chemicals is entirely by contact with the fruit (5). It is well recognized that abscission is a biological process, and is temperature dependent.

The purpose of this paper is to summarize experimental fruit removal results achieved during the 1978-79 fruit season in Florida using abscission chemicals and a newly designed conical scanning air shaker for harvesting bedded groves prevalent in south Florida. Fruit collection and handling is covered in another publication (3).

Material and Methods

Trees were sprayed with air carrier sprayers. Sprayers were nozzled so that approximately two-thirds of the solution was applied in the top one-

Table 1. The effects of date of application and temperatures on the performance of abscission chemicals and air shaker on fruit removal of 'Hamlin' oranges at LaBelle, Florida.

Spray date	Treatment[z]	Days after appl.	60° & above dg-hrs[y]	FRF (lb) & SD	Preharvest drop (%)[x]	Temp 1st day	Air shaker removal (%)[w]
1/18	100 + 2.5	4	629	2.95 ± 2.47	87	76-49	96.7
1/25	100 + 2.5	6	240	5.34 ± 2.53	18	57-42	98.0
2/ 2	100 + 2.5	4	302	1.87 ± 1.65	92	64-40	99.4
2/ 9	100 + 2.0	4	236	3.39 ± 1.83	8	68-34	96.2
2/14	100 + 1.5	4	794	2.63 ± 1.82	65	77-47	99.2
2/22	100 + 1.5	4	1200	1.90 ± 0.98	97	84-66	99.4
2/22	5 qts/500(PO)	4	1200	2.03 ± 1.35	76	84-66	99.4
Control	(handpick)	-	--	11.98 ± 2.60	0.5	-	99.1

[z]Treatment on 1/18 was applied with FDOC modified Agtec sprayer; all others were applied with FMC 757 (double oscillating volute) sprayer. Treatments were combinations (Release + Acti-Aid) of abscission chemicals except the 2/22 treatment was Pik-Off (PO) at 5 qts/500 gal (300 ppm).

[y]Computed from official NOAA weather thermographs for LaBelle, Florida (located at Alico).

[x]Trees averaged 825 fruit.

[w]Air shaker used was FDOC experimental model with conical scanning air delivery system.

third of the trees. Nozzles were large-orifice (dilute) type to obtain large droplet sizes for better fruit coverage. Sprayer ground speed was three-fourths mph (1.2 kmh) and application rate was 750 gallons (2839 ℓ) per acre (0.4 ha). The FDOC modified Agtec Sprayer was used on the first test; an FMC 757 (double oscillating volute) Speedsprayer was used on all subsequent tests.

Abscission chemicals used in the test were tank mix combinations of Release (5 - chloro - 2 - methyl - 4 - nitro - 1H pyrazole) and Acti-Aid (cyclo-heximide) at concentrations of 100 ppm Release + 1.5-2.5 ppm Acti-Aid with 0.1 per cent Ortho X-77 surfactant. Pik-Off (dioxylglyoxime) was used in one test (no surfactant). Trees were 15 years of age, height was 13 feet (4.0 m) and every other tree was cross hedged. Tree planting distances were 15 feet (4.6 m) x 25 feet (7.6 m) on eight-row beds with no water furrows; treatments were of single row either one-fourth mile (0.4 km) or one-half mile (0.8 km) in length.

Fruit removal force (FRF) readings and fruit drop counts were made from five or more randomly selected trees in the row. Leaf drop observations and other pertinent data was also collected from these trees. Fruit removal efficiency was obtained by randomly counting the fruit remaining on 20 trees from each treatment and by computing total number of fruit on trees from weight of fruit recovered in the harvest operations. Removal efficiency was compared to that obtained from an adjacent block handpicked by a commercial crew.

Temperature for these tests and other comparative temperature data were collected from thermographs located in or near treatment plots where mechanical harvesting operations were conducted regularly. Computation of degrees x hours (dg-hrs) (an integration of the area 60°F (15.6°C) and above on temperature-time chart) for each day was manually obtained from these official thermograph records.

An air shaker (Figure 1) designed and built by the FDOC at AREC, Lake Alfred, utilizing a conical scanning air delivery system, was used for removing the fruit. The machine used a 54-inch diameter vane axial fan driven by diesel engine rated at 150 continuous horsepower. Air was applied to the tree by means of a fixed vane assembly rotated about the axis of air flow, thus distributing the air in a conical pattern as the machine progressed down the tree row. The trees were shaken by making a pass down each side of the row.

During harvest operations the fan center was positioned to a height of seven feet to obtain a shaking action of the tree skirts and at the same time deliver enough air to the top part of the tree for maximum fruit removal.

The shaker was operated at a forward speed of one mph (1.6 km/hr), a fan speed of 1500 rpm (25 Hz) and an oscillator rotation rate of 70 rpm (1.2 Hz). These machine settings