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EFFECTIVE CHILLING TEMPERATURES FOR LOW-CHILL SUBTROPICAL PEACHES

ROBERT E. ROUSE[1]
University of Florida, IFAS
Southwest Florida Research and Education Center
2686 State Road 29 North
Immokalee, FL 34142-9515

WAYNE B. SHERMAN
University of Florida, IFAS
Horticultural Sciences Department
P.O. Box 110690
Gainesville, FL 32611-0690

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Abstract. **Low-chill peach (*Prunus persica*) cultivars adapted to subtropical conditions of south Florida with commercial quality have been developed and are available. These cultivars require from <100 to 200 chill units, ripen in April and May, and have fruit size greater than 2.0 to 2.5 inches in diameter. These cultivars have flowered profusely each year and fruited with acceptable crops over the past 5 years. During this period Florida has experienced some of the mildest winters of the past century. Weather records and chill unit models suggest that trees did not always experience the required chill units (hours of temperatures at or below the recognized requirement of 45 °F), yet they flowered and fruited. This would suggest that temperatures of 50 to 55 °F or higher are effective at satisfying the chilling requirement of these low-chill subtropical cultivars.**

Subtropical peach trees, like other deciduous fruit trees, require cool temperatures during the winter for leaf and flower bud dormancy to be satisfied before growth will resume in the spring. This "chilling" requirement is measured in units: the maximum amount of chilling that can be satisfied in one hour at an optimum temperature (Richardson and Walker, 1974). The optimum temperature for chilling in temperate zone peach cultivars is believed to be near 45 °F (Chandler and Tufts, 1934; Weinberger, 1950; Weinberger, 1956). Low-chill, subtropical, peach cultivars acquire chilling at higher temperatures (Guardian and Biggs, 1964), and have performed satisfactorily without temperatures below 45 °F when experiencing winter cold of 55 °F and above (Sharpe, 1969). Nevertheless, inadequate chilling can result in delayed and erratic flowering and foliation, reduced fruit set, and indirectly oblong-pointed, suture bulge, and misshaped fruit.

Dormancy and what constitutes chilling temperatures is not clearly defined, nor is the point in time to begin recording chilling temperatures. Various models have been developed to calculate chilling. Each model defines what it uses as a chilling unit. The three most common models are: the number of hours below 45 °F model, the number of hours between 32 and 45 °F model, and the Utah model which is more complex because it introduces the concepts of relative chilling effectiveness and negative chilling (Byrne, 1992). These models were all developed in temperate zone states where high-chill-requirement peaches are grown, and their application to areas where low-chill cultivars are adapted has not been useful (Evez and Lavee, 1971).

The mean-temperature model appears best adapted for use with low-chill cultivars. Researchers in Georgia and Florida (Sharpe et al., 1990; Weinberger, 1956) independently developed a relationship between mean-monthly temperatures (December and/or January) of the coldest month(s) and total chill units accumulated. Combining data from both studies, Byrne (1992) generated a model that worked for the low- and medium-chill regions of south Texas. Using the January mean temperature, Total Chill Accumulation = 3547-54 (January mean temperature), and using the December-January mean temperature, Total Chill Accumulation = 4280-68.8 (December + January mean temperature/2). Another model using the January mean temperature was developed using the Weinberger (1956), data and adapting it to low-chill subtropical peaches (Sherman and Rodriguez-Alcazar, 1987). This model chilling = -1,174 + 27,585/January mean (°C) - (-75,466/(January mean)^2 (Okie, 1998).

Peach trees in south Florida (Rouse and Sherman, 1989a; Rouse and Sherman, 1998) experience mild winters that may not provide sufficient chilling to satisfy the mathematical models that are based on temperatures below 45 °F. The objective of this report is to document that subtropical low-chill peach cultivars will flower and produce a crop of fruit without experiencing the required amount of temperatures at or below 45 °F.

Materials and Methods

In 1996 subtropical adapted, low-chill peach cultivars 'Flordaprince' (Sherman et al., 1982), 'TropicBeauty' (Rouse and Sherman, 1989c), 'UFGold' (Sherman and Lyrene, 1997), 'Flordaglo' (Sherman and Lyrene, 1989), 'TropicSnow' (Rouse and Sherman, 1989b), and several numbered genotypes were budded to Flordaguard peach rootstock and planted in southwest Florida at the UF/IFAS Research & Extension Center near Immokalee (26°27'N, 81°26'W). These scion cultivars are all rated at between 100 and 200 chill units. Chilling was determined for each winter season from 1997-98 through 2002-03. The chilling was calculated based on hours equal or below 45, 50, 55, and 60 °F, the mean January (Sharpe et al., 1990; Weinberger, 1956), and mean January-December (Byrne, 1992) temperature for each season. Calculated chilling for each season was then compared to observed ratings of uniform flowering and fruit set.

Results and Discussion

The current chilling models, including the Mean Temperature Model using January mean temperature as an indicator of chilling received, do not seem adequate for determining chilling in these subtropical low-chill cultivars rated at 150 or less chill units. The fact that the cultivars rated 150 chill units bloomed profusely and produced excessive crops most years, but did not receive the calculated adequate chilling according to hours below 45 °F or the Richardson (1974) model in four of the six years (Table 1) supports previous findings (Guardian and Biggs, 1964; Sharpe, 1969;

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[1]Corresponding author.

Table 1. Chilling units at Immokalee based on Dec. + Jan. cumulative hours at or below 45, 50, 55, and 60 °F, calculated chilling according to the Dec.-Jan. mean model, and Jan. mean models for six seasons (1997-98 through 2002-03).

Season	Cumulative hours at or below °F				Byrne model		Sharpe et al. Jan. mean[y]	Bloom[x] (%)	Crop[x] (%)
	45	50	55	60	Dec.-Jan. mean[z]	Jan. mean[z]			
1997-98	40	112	248	440	-236	-6	79	100	90
1998-99	43	110	176	305	-364	-22	75	100	100
1999-00	100	208	310	480	-134	134	205	90	100
2000-01	182	341	528	735	133	447	398	100	80
2001-02	76	129	224	390	-265	53	109	100	70
2002-03	189	337	508	718	174	496	446	80	60

[z]Chilling calculated according to the Mean Temperature Models using the Dec.-Jan. or Jan. mean temperature as described by Byrne (webpage http://aggie-horticulture.tamu.edu/stonefruit/).
[y]Chilling calculated according to the Mean Temperature Model using the Jan. mean temperature adapted from Weinberger 1956, and Sherman and Rodriguez-Alcazar 1987, as described by Okie 1998.
[x]Mean rating of five cultivars; 'Flordaprince', 'TropicBeauty', 'UFGold', 'Flordaglo', and 'TropicSnow', and several numbered genotypes.

Sharpe et al., 1990) that low-chill clones are effectively chilled at progressively higher temperatures than high-chill clones, effectively to temperatures near 60 °F (Sharpe et al., 1990). Some areas around the world can fruit peach cultivars even though half or less the number of recommended hours below 45 °F are received (Sharpe et al., 1990).

It would appear from Table 1, that hours at or below 55 °F were sufficient to indicate the accumulation of chilling for peach cultivars in the 100 to 150 chill unit range. Hours at 55 °F indicate chilling was satisfied each year and was demonstrated by tree performance. Hours at 50 °F would have satisfied cultivars requiring between 100 and 150 chill units. Subtropical adapted, low-chill cultivars all performed well setting fruit buds, flowering, and producing commercial crops of fruit. This is supported by previous reports that show low-chill cultivars perform perfectly well having never experienced adequate temperatures in the 40s F (Guardian and Biggs, 1964; Sharpe, 1969; Sharpe et al., 1990).

Delayed defoliation, a classic symptom of insufficient chilling, was never observed in these subtropical low-chill cultivars. Comparison with similar trees on the main campus at Gainesville, 250 miles north of Immokalee, receiving 300 to 400 chilling units, noted that flower and vegetative bud break at Immokalee were at the same time or a few days earlier. Shoot growth at both locations has been extensive and required summer pruning. Reduced fruit set and buttoning due to insufficient chilling was not observed in any of the six seasons monitored at Immokalee. In 2000-01 and 2001-02 seasons, 'UFGold' failed to set a crop due to a genetic inability to set fruit when mean-night temperatures during bloom are at or above approximately 56 °F (Rouse and Sherman, 2002). This phenomenon in 'UFGold' is credited for reducing the mean crop ratings in 2000-01 and 2001-02 seasons. While typical responses to inadequate chilling such as delayed bud break and leaf growth, and reduced fruit set, are dramatic and easily noticed, they have not been observed. Other effects of insufficient chilling that affect fruit quality are less noticeable. These fruit quality characteristics manifest as fruit with enlarged and pointed tips on the blossom end. Some fruit at Immokalee do develop small pointed tips, but this is attributed to warmer temperatures that occur during early fruit development. Color development is enhanced by higher light intensity with about 20% greater external red blush at Immokalee as compared to the same clone grown in north Florida.

In summary, it appears that subtropical, low-chill, peach cultivars in the 100 to 150 chill unit range set adequate crops at Immokalee without experiencing the required temperatures of 45 °F and accumulated sufficient chilling at temperatures near 55 °F. This is evidenced by the fact that these cultivars have produced fruit buds, flowered profusely, and set crops consistently over six seasons in southwest Florida. Current chill unit models developed elsewhere may be suited for low-chill cultivars in the 300 to 400 chill unit range, but do not account for the accumulation of chilling by subtropical cultivars in the 150 chill unit range and below.

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