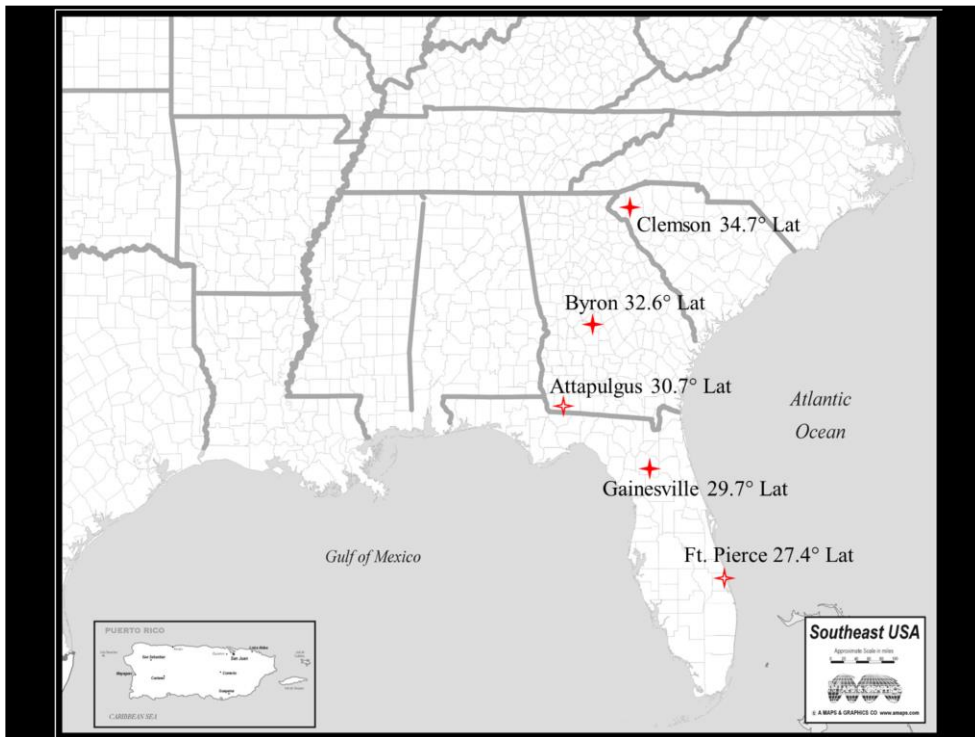


Progress in Peach Variety Development for the Lower Coastal Plain

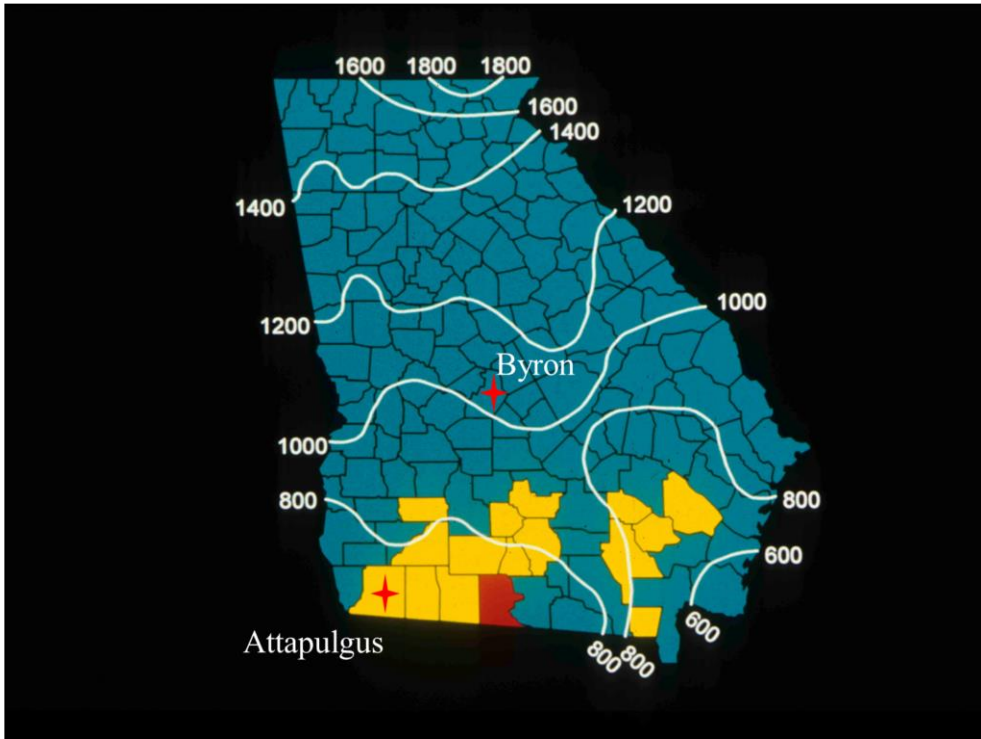
Tom Beckman, USDA-ARS

As presented at the Annual Stone Fruit Workshop and Field Day held May 29, 2018 at the UF/IFAS Plant Science Research and Education Unit, in Citra, FL



I have been involved with the development of moderate chill peach varieties for the lower coastal plain industry since I arrived at Byron in 1988. This is a unique production zone, separate from the main season (high chill) production areas in middle Georgia and South Carolina and the production areas in North and Central Florida (low and ultra low chill, respectively). Support for these industries is provided by breeding programs located at Clemson University, the USDA-ARS lab in Byron Georgia (main season – high chill areas), the UGA REC in Attapulgus (moderate chill) and the University of Florida (Gainesville, FL, with a satellite evaluation site in Ft. Pierce, FL).

The moderate chill program is a collaborative effort involving the USDA-ARS (Byron, GA), the University of Georgia (Attapulgus, GA) and the University of Florida (Gainesville, FL). The potential production area for these varieties is large, running along the Atlantic coast of South Carolina across a swath of South Georgia/North Florida, and along the gulf coast into Texas.



Georgia chill hour map showing counties with significant number of moderate chill varieties in yellow and most important center of production in red. (Brooks County)

Variety Development

Priorities

- Cropping Reliability
- Improved Firmness
- Disease Resistance
- Improved Appearance and Size
- Improved Eating Quality

These are our main priorities. When I started on this project in 1988 I wondered what all the worry was about reliability. Initially, we enjoyed very favorable spring weather and most items produced full or near full crops. Then 1996 happened and numerous repeat episodes of either inadequate chill or late spring freezes since then.

This industry is a shipping industry which requires exceptional fruit firmness in order to survive long distance shipping without damage.

This area also has significant disease pressure that must be addressed in the breeding process as well attention to fruit appearance, size and eating quality.

Cropping Reliability

- Accumulating Sufficient Chill to Bloom ‘Normally’
- Avoiding Spring Frost

Cropping reliability is job one. It has several elements that can be addressed through breeding. The first is to produce new materials with a chilling requirement that can reliably be fulfilled annually during the dormant season, i.e. not too high a chilling requirement as failure to meet a variety’s chilling requirement has consequences. However, the other side of this coin is to not produce materials with too low a chilling requirement that would allow them to bloom before the danger of spring frost has passed. Presumably there is a ‘Goldilocks’ range in each production area.

The ‘Rule of Thumb’ for selecting appropriate chilling requirement cvs. for a particular growing area:

1. Not more than $\frac{3}{4}$ of the long term average (in order to avoid coming up significantly short and therefore unable to set a full crop)
2. Not less than half of the long term average (in order to avoid blooming too early and being vulnerable to freeze damage)

Consequences of Inadequate Chilling

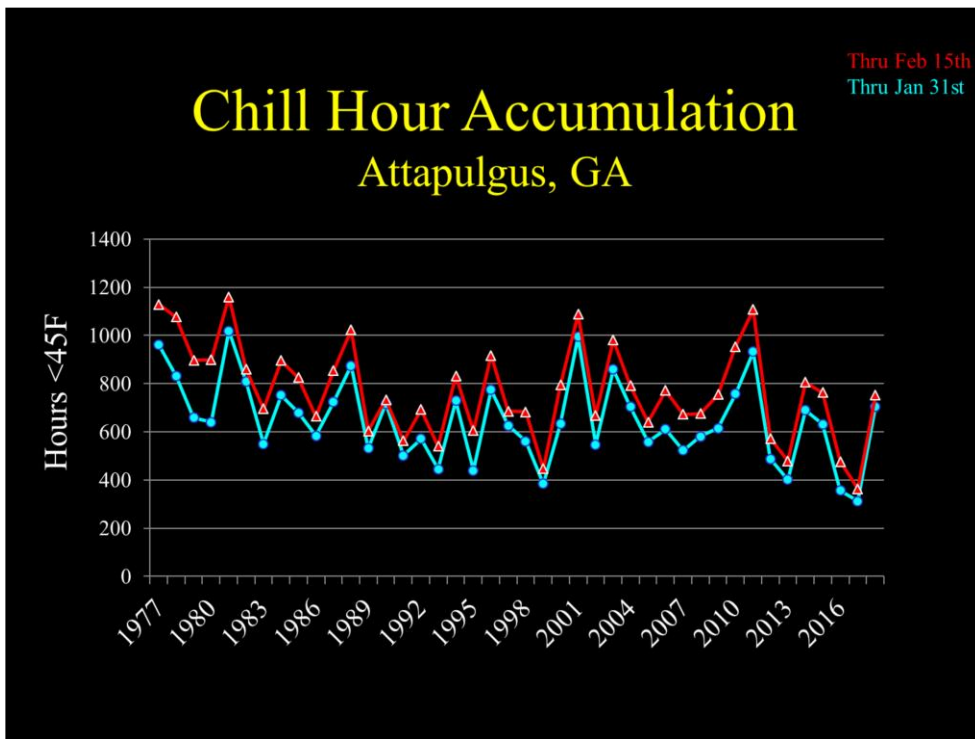
| Chilling Received | Likely Outcome |
|--------------------|--|
| Fulfilled/Exceeded | Normal veg and floral dev, full crop |
| > 90% | Slightly delayed veg and floral dev., but still likely full crop potential |
| 80-90% | Delayed veg and floral dev., likely reduced set and possible crop impact |
| 70-80% | Significantly delayed veg and floral dev., significant crop reduction |
| < 70% | Profound delay, flower abortion, prob. crop loss and possible dieback and impact on following season |

So what are the consequences of **inadequate** chilling? Falling a little short usually isn't fatal, but as one falls shorter, fruit set and crop potential is progressively impacted. Falling profoundly short can mean no crop set whatsoever.

Why Reduced Set?

- Delayed bloom means increased likelihood of higher temps during bloom which impacts pollen germination and flower set.
- Direct impact of inadequate chill on flower viability (Bud Failure).

Failure to fulfill a variety's chilling requirement negatively impacts fruit set for 2 reasons.



The lower coastal plain is a tough area to breed for. From this graph you can see that chilling is extremely variable in South Georgia. In 2000 the long term average chill (50 year) accumulation through Jan. 31st was 674 hours (through Feb. 15th is ~779). Over the last 10 years the average has been only 589 (a drop of more than 10%). In 2017 we set a new all time record of only 312 hours through the end of Jan, breaking the previous record of 356 set just the year before. This does not bode well for Sunfre, June Gold and Redskin, our 525, 650 and 750 bloom standards, respectively.

The Rule of Thumb suggests that, based on historical records, the chill range should be between ca. 350 and 500 hours. However, based on the last ten years it would suggest between ca. 300 and 450. Our experience has been that a chill requirement between 350 and 450 offers the best balance between avoiding spring frosts and achieving full or near full chilling most years. However, as you'll see, in practice there is no perfectly safe chill requirement that addresses both issues every year.

CU Accumulation and Last Frost Dates

| Spring of | Chill (thru Jan 31 st) | Last Freeze (< 28F) | 'Safe' Chill Classes |
|-----------|--|-------------------------|-------------------------|
| 2011 | 933 | Feb 13 | ≥ 250 |
| 2012 | 487 | Feb 13 | ≥ 450 |
| 2013 | 404 | Feb 18 | ≥ 450 |
| 2014 | 689 | Jan 31 | ≥ 250 |
| 2015 | 631 | Feb 20 | ≥ 350 |
| 2016 | 356 | Jan 25 | ≥ 250 |
| 2017 | 312 | Mar 16 | ≥ 525 |
| 2018 | 705 | Jan 19 | ≥ 150 |

This figure summarizes the chill accumulation and last hard freeze date* for the last 8 seasons. In 3 of the 8 seasons one would have expected some freeze damage to presumably adapted materials, i.e. those in the 300-450 range. Moreover in at least 3 of those seasons one would have expected some problem with inadequate chill in the highest chilling materials in the adapted range.

2017 was a particularly rough year. "On paper" it would appear that every chill range would have either suffered inadequate chilling, freeze damage, or both! As things developed, only the lowest chill materials, i.e. < 350 chill hours received enough chill to bloom normally. Fortunately, other than the March 16th event the only other freeze event of importance that spring occurred Jan 9th, over a week before the lowest chill materials (ca. 150 cu) bloomed. Consequently, the lowest chill materials all had considerable canopy developed by the time the March 16 event occurred and a sizeable portion of their crop made it through presumably by hiding the fruit from the night sky (and preventing further radiative cooling). Nonetheless, of the 200+ fruiting age selections and varieties present in 2017, only 4 carried 50% of a crop or better and all were in the sub 350 chill hour classes.

*Note the last hard freeze date does not take into account the added impact of radiative cooling below the reported low air temperature on a given date. Radiative cooling often significantly exacerbates cold damage to flowers and fruit but is seldom

forecast or reported by the weather service. Only on site monitoring will reveal the extent of such damage. To anticipate the possibility of such an event you need detailed information on cloud cover, wind speed and dewpoints for the pre-dawn hours. This information is available, for example, in the hourly forecast from NOAA (see side for web links at end of presentation).

Improved Firmness

- Fresh market varieties are ‘Melting Flesh’
- Most processing varieties are ‘Non-melting Flesh’

Picking peaches for shipping means walking a tightrope between too ripe to ship, i.e. too soft, and too immature to sell, i.e. too green. In a nutshell, melting type peaches soften rapidly as they approach ripeness. Non-melting types have a mutated gene for one of the enzymes responsibility for flesh softening which significantly slows this process. This trait is what allows canning peaches to survive the sterilization process without undue flesh breakdown. The now retired UF peach breeder, Wayne Sherman, pushed for the use of non-melting germplasm as a way of dealing with the premature softening we were seeing in our initial efforts using traditional melting type parents. He developed prototype non-melting fresh market types that convinced us that this approach was viable and in 1995 we completely changed our approach. We’ve never looked back. It works.

Non-Melting Canning Type



Most processing cultivars lack much skin blush (or red in the flesh) because red pigment turns brown during processing and 'brown' is interpreted as 'decayed'. Moreover, they are typically high chilling and long season. Adapting them for this early season, moderate chill fresh market industry took considerable breeding effort.

Disease Resistance

- Bacterial Spot
(*Xanthomonas campestris*)
- Peach Fungal Gummosis
(*Botryosphaeria dothidea*)

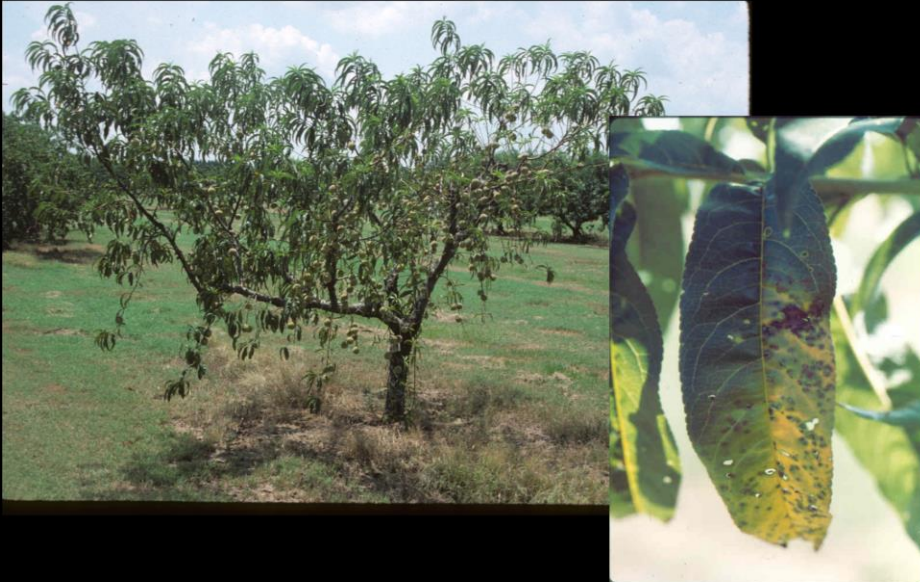
Two diseases are of importance to the SE Peach Industry.

Bacterial Spot



First and foremost is Bacterial Spot. A bad infection on fruit can take your entire crop down.

Bacterial Spot



Leaf infection can result in severe defoliation of trees. Disease pressure varies considerably from year to year so we retain several high susceptibility selections in the program so we can judge the bacterial spot pressure each year. In high pressure years we look for other highly susceptible selections and eliminate them. Fortunately, we have materials in the breeding program with fairly good resistance to this disease. Nonetheless, when infection pressure is high genetic resistance can prove inadequate and we have to rely on copper based spray materials to reduce bacteria populations.

Peach Fungal Gummosis



Fungal gummosis is more insidious. On high susceptibility varieties you can suffer yield losses of up to 40%. Severe infections will kill fruiting wood and even young trees. We have yet to find a registered fungicide that will control this disease which makes genetic resistance a priority in our program.

New Peach Varieties for the Coastal Southeast

USDA, UGA and UFL Cooperating
Attapulgus, GA

Update on recent releases and 'coming attractions'. This is a cooperative program involving the USDA-ARS and the University of Georgia and the University of Florida.

Gulfking Peach



Gulfking was released in 2003 as an alternative to Flordaking (released in the early 80's)

Gulfking

- 350 chill hours
- Ripens in early May
- Yellow, non-melting flesh
- Attractive, reliable and good size

(AP98-04)

Released in 2003 as a replacement for Flordaking. It is comparable chilling but has a better cropping record than Flordaking. It gives up a little bit on size but has considerably better appearance and firmness.

Flordaking vs. Gulfking



Gulfking is clearly a more marketable product than Flordaking. You will note the split pit in Flordaking. This is a big problem for Flordaking, some seasons resulting in 20% of the crop being left in the field because the split was visible at the stem. We've found that our non-melting materials have very little problem with this issue.

Gulfcrest Peach



Gulfcrest was released in 2003 as an alternative to Flordacrest. We are now about a week later into the season. Gulfcrest offers a comparably size fruit with substantially better appearance, quality and firmness for shipping. However, Gulfcrest also has a substantially higher chilling requirement than Flordacrest which in low chill years has caused it to bloom late and miss its market window by a week or more. Its cropping record is not as reliable as Flordacrest either due to several low chill years since its release. These are problems we are about to fix with the release of another selection ripening in this window with a 350 chill hour requirement.

Gulcrest

- 525 chill hours
- Ripens in mid-May
- Yellow, non-melting flesh
- Attractive and good size

(AP98-10)

Released in 2003 as a potential non-melting replacement for Flordacrest (melting)

Flordacrest 'Season' Selections



Gulfcrest is better colored and better shaped than Flordacrest. FL96-18C is the likely replacement for Gulfcrest. It has hit its market window more reliably than Gulfcrest and has an excellent cropping record overall.

Gulfcrimson Peach



Gulfcrimson was released in 2007 as an alternative to June Gold. It has proven to be a reliable cropper. It is larger, better looking, higher quality and firmer than June Gold.

Gulfcrimson

- 400 chill hours
- Ripens in late May
- Yellow, non-melting flesh
- Attractive, exceptionally reliable and very good size

(AP01-07)

Released in 2007, Gulfcrimson is probably our best release to date for the shipping industry

June Gold vs. Gulfcrimson



Gulfcrimson has the red blush and shape that buyers are looking for

Gulfprince Peach



Gulfprince was released in 1999 as a prototype non-melting flesh peach variety for use in the fresh market shipping industry.

Gulfprince

- 400 chill hours
- Ripens in early June
- Yellow, non-melting flesh
- Adequate color, exceptionally reliable and very good size

(FL93-14C)

Released in 1999, Gulfprince was the first non-melting type released by this cooperative program. It has been one of the most reliable croppers developed in this program. It ripens in early June, essentially as this industry's shipping season closes as the main production areas in middle Georgia and South Carolina start putting out substantial volume. It has proven to be a good replacement for Juneprince, the previous standard in this season. Gulfprince offers superior cropping, better size, quality and firmness, sufficient for shipping if needed. However, it suffers a bit in appearance in this age. We are planning to replace it with another selection, AP03-11, that provides significant improvements in the looks department.

Juneprince 'Season' Selections



AP03-11 stands out for its better red and overall better appearance, more like what we're looking for in a series.

Gulfsnow Peach



Gulfsnow, released in 2011 is the first white fleshed variety from this program.

Gulfsnow

- 400 chill hours
- Ripens early June ~10 days after June Gold
- White, non-melting flesh
- Attractive and very large

(AP06-09W)

Gulfsnow was released in 2012. We expect to follow it with 3 or 4 more earlier ripening whites in the next couple of years in order to construct a series that can be used in this industry's shipping window. At this time Gulfsnow has no competition adapted to this chill zone or market window.

'Gulfsnow' vs. June Gold and Snow Queen



Gulfsnow's superior size, shape and red color are evident in this photo. We used Snow Queen for comparison because there are so few other white fleshed varieties that are adapted to this production area.

GulfAtlas Peach



GulfAtlas was released in 2013. It is a late ripening non-melting peach that matches our ideotype, i.e. very round and well colored fruit, like Gulfking and Gulfcrimson.

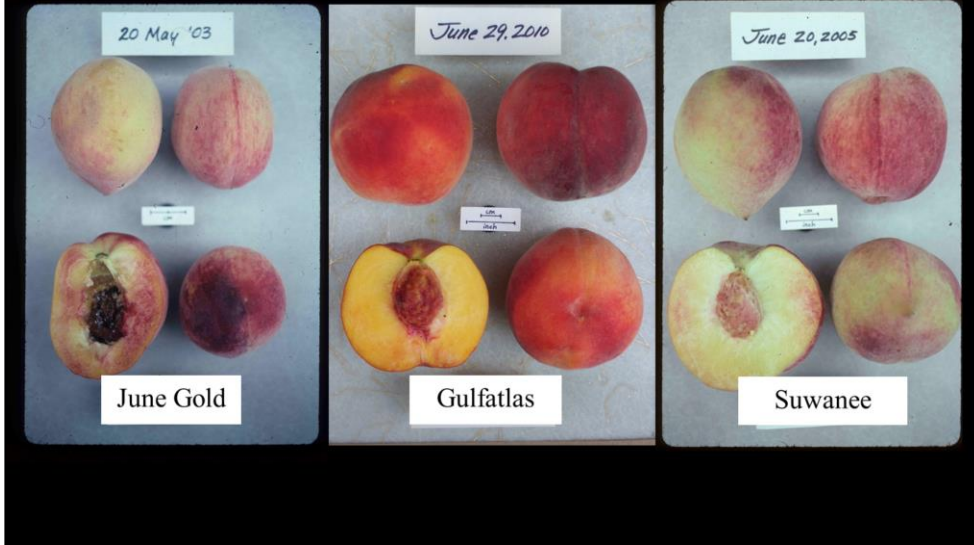
GulfAtlas

- 400 chill hours
- Ripens in mid-June
- Yellow, non-melting flesh
- Attractive, high quality and very large

(AP03-22)

GulfAtlas was released in 2013. It is an exceptionally large yellow flesh peach with shippable firmness should this industry want to go this late.

Gulfatlas vs. June Gold and Suwanee



Gulfsnow's superior size, shape and red color are evident in this photo.



Mid-Pride

450 cu

Ripens mid-late June

Mid-Pride was not developed by this program but we think it has a place in this chill zone. Mid-Pride is out of the Zaiger Genetics program in California but is no longer patented. Mid-Pride is a large, late ripening melting peach with good a good cropping record that we think has potential for local sales and u-pick but lacks sufficient firmness for long distance shipping in our opinion.

Mid-Pride

- 450 chill hours
- Ripens in mid-late June
- Yellow, melting flesh
- Traditional looks, freestone,
high quality and large
(Zaiger Genetics)

Mid-Pride

Gulfatlas vs. Mid-Pride



Gulfatlas' superior size, shape and red color are evident in this photo. Nonetheless, Mid-Pride has some advantages for the roadside market. It has a traditional shape and appearance and is freestone, whereas Gulfatlas is cling. By mid-June customers are expecting to see some freestones.

Development of Peach Varieties for SE Lower Coastal Plain



Early season peaches suffer from a less than shining reputation among retailers and consumers. Chief complaints have been low and inconsistent fruit quality, firmness and flavor. The cooperative regional project involving the USDA and the Universities of Georgia and Florida has taken a novel approach to the problem by developing fresh market cultivars utilizing non-melting germplasm. Non-melting type peaches soften much more slowly than conventional melting types which allows the fruit to hang on the tree several days longer. This provides more size, red color and, most importantly, better flavor without sacrificing the firmness needed for long distance shipping. At this time both Gulfkings and Gulfcrimson have or are about to overtake this industry's previously dominant varieties, Flordaking and June Gold, respectively, in tree numbers.

Weather Websites:

- **National Weather Service Historical Data**
 - ✓ <http://w2.weather.gov/climate/xmacis.php?wfo=ffctotal>
 - ✓ <https://www.ncdc.noaa.gov/climate-information/statistical-weather-and-climate-information>
- **National Weather Service Hourly Forecast**
 - ✓ <https://www.weather.gov/wrn/hourly-weather-graph>
- **Various Models for Calculating Chilling**
 - ✓ <http://www.getchill.net/>
- **Chill Hours and Projections**
 - ✓ <http://agroclimate.org/tools/chill-hours-calculator/>

Useful websites for:

1. Assessing historical averages
2. Weather data for predicting radiative freezes
3. Chill calculations by various models
4. Chill accumulation and forecast based on historical data

