Technology Choices for a Profitable 21st Century Peach Farm

International Tree Fruit Association 56th Annual Conference February 25, 2013





Peach Production Challenges

- Spring frost/freeze/hail
- Climate warming (?) and water availability
- Peach tree short life, bacterial canker and Armillaria (oak root rot)
- Fruit size and quality market/consumer driven
- Reducing labor cost/increased mechanization & efficiency
- Disease control (brown rot and bacterial spot)
- Insect control (plum curculio, scales, borers, stinkbugs, fruit fly)
- Concerns about plum pox virus (Sharka)

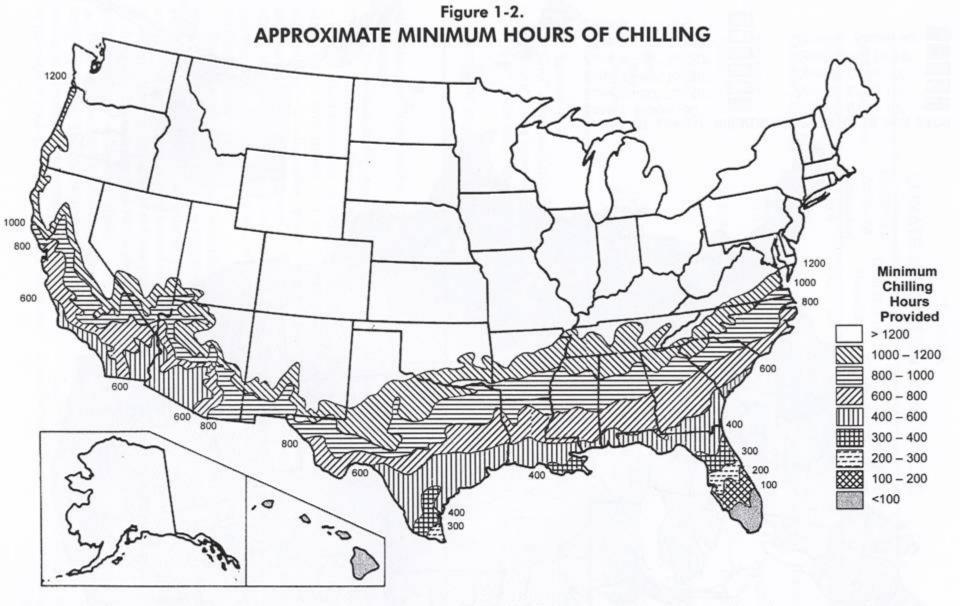
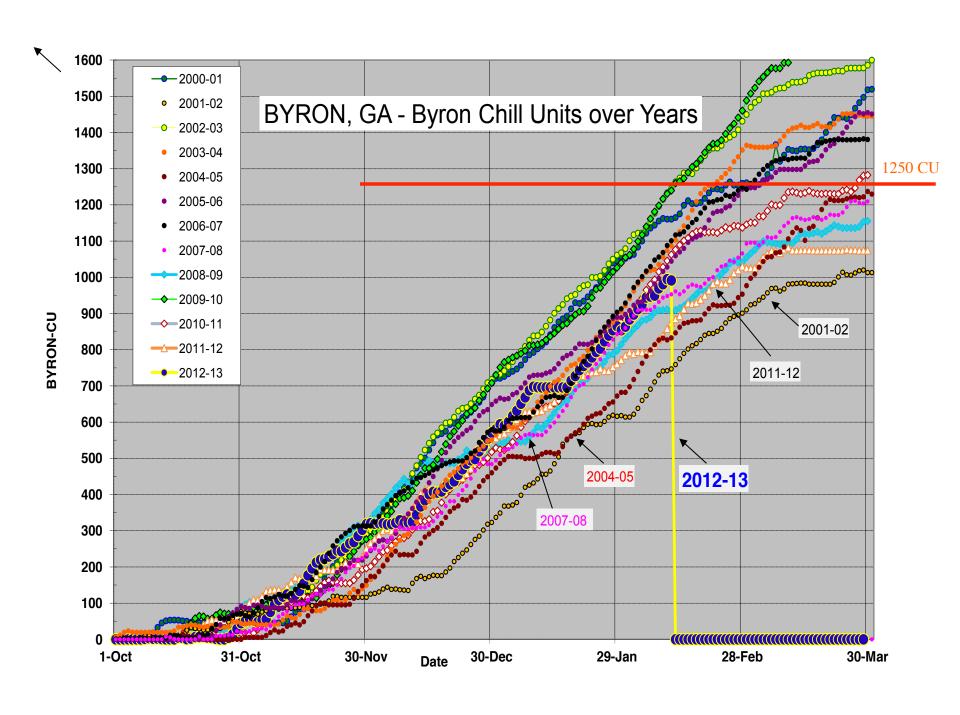


Figure 1-2. This map represents minimum total hours of winter tempratures below 45° and above 32°F. Chilling hours may be much greater during some seasons. The map is generalized and many local variations exist, particularly in mountainous areas.

Drawn by Brenda Olcott-Reid based on maps and data provided by Dr. George Ray McEachern of Texas A&M University and Dr. William R. Okie of USDA.

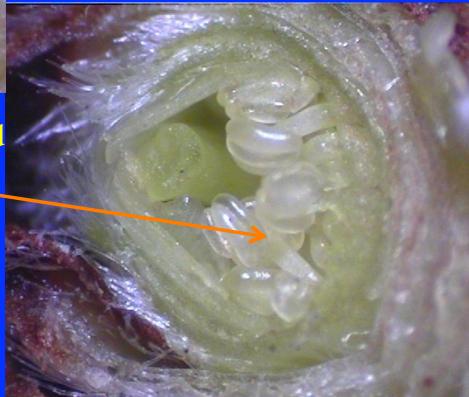




Redglobe flower bud with pistil and underdeveloped anthers—

Dormex® - hydrogen cyanamide (a.i. 49% H2CN2) or BudPro® (a.i. 50% H2CN2)

Contender flower bud

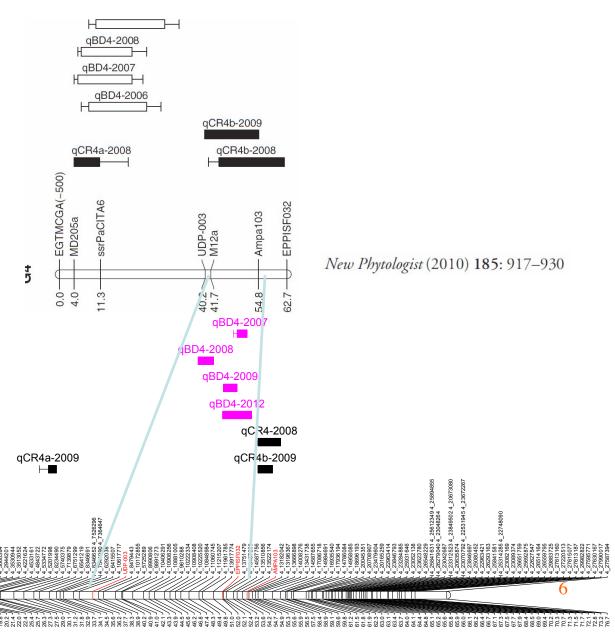


Chilling and bloom QTL detection

Comparison between population mapped with SSRs/AFLPs and independent population mapped with GBS

- Completely independent populations
- Phenotyped in identical conditions

G





Ethephon (100 ppm left, control right)









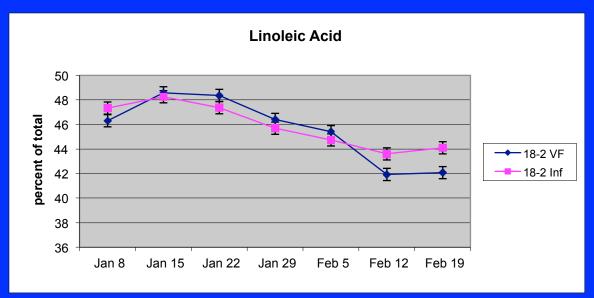
Prunus Latent Mosaic Viroid

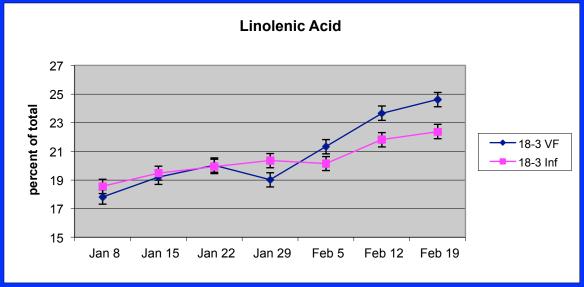
PLMVd infuence on Redglobe harvest

Harvest Delay	Harvest Period
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Year	(days)	(days)
2008	13	23
2009	14	26
2010	5	16
2011	7	17







Peach Replant Disease: Pre-Plant Fumigation Options?

- No methyl bromide
- Telone II and Telone C-17 (27-35 gals./acre)
- Cover crop rotation 2 years prior to planting





Preplant wheat/sorghum rotation for ring nematode control, a commercial practice in lieu of fumigation (GA, SC)



Incorporating Brassica green manure for nematode control, as effective as fumigation (mid-Atlantic states) (Nyczepir)

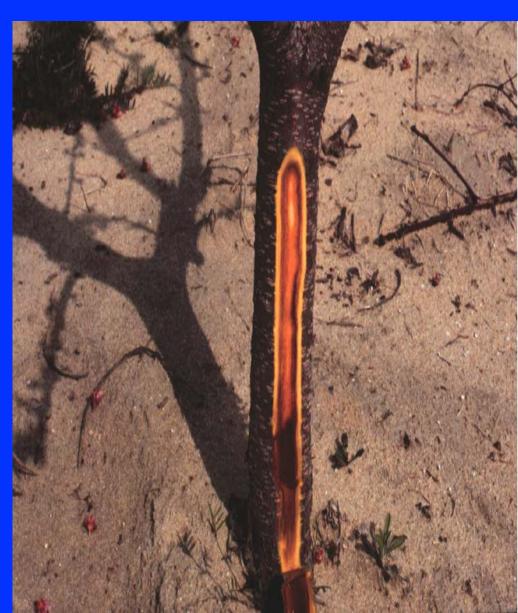


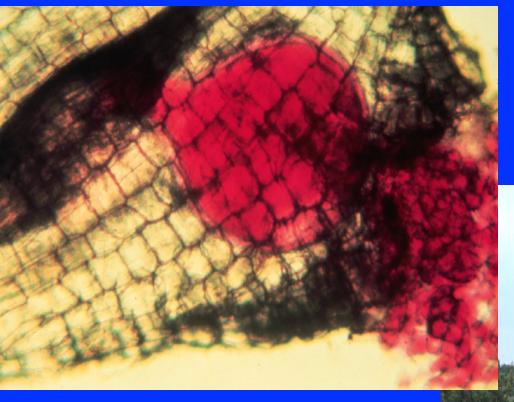
Soil solarization



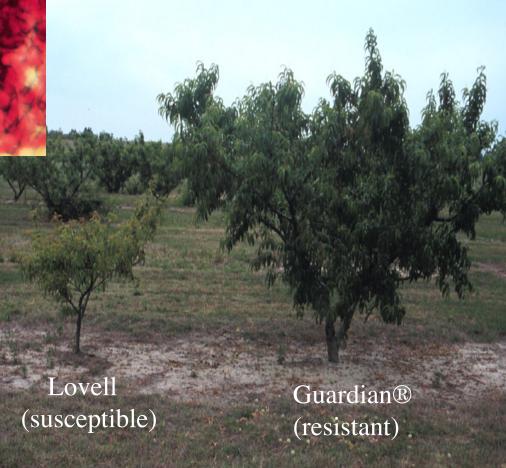
Rootstocks Influencing Tolerance to Bacterial Canker

- Guardian® excellent
- Viking excellent
- MP-29 excellent





Root-knot Nematodes (Meloidogyne spp.)



Root-knot Nematodes

Immune or Tolerant to M. incognita and M. javanica

Guardian®, Nemaguard, Flordaguard, HBOK#s (Harrow Blood x Okinawa)

Adesoto 101 (P. insititia)

Penta (P. domestica)

Krymsk® 1 (*P. tomentosa* x *P. cerasifera*)

Sharpe (*P. angustifolia* hybrid) & MP-29 (peach x plum)

Barrier 1 or Empyrean® 1 (P. persica x P. davidiana)

Cadaman® (*P. persica* x *P. davidiana*)

Pumiselect® (P. pumila)

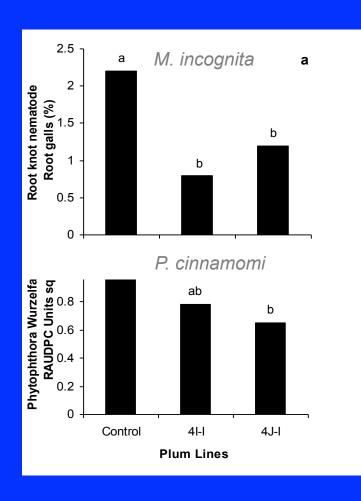
Felinem, Garnem, and Monegro (*P. dulcis* x *P. persica* cv. Nemared)

Replantpac (*P. dulcis x P. cerasifera*)

Densipac (P. besseyi x P. cerasifera)

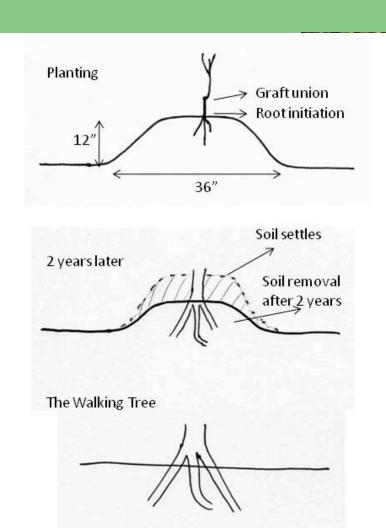


Gastrodian protein (GAFP) from a Chinese orchid increases disease resistance in transgenic plums





Unearthed root crowns, the "walking tree"









Air Gun for Root Excavation



Waterlogging tolerant Rootstocks (root asphyxia)

- Viking & Krymsk® 86 more tolerant than peach
- Cadaman also better than peach
- Plums and plum hybrids generally are tolerant such as Penta, Tetra, Adesoto 101, Krymsk® 1
- Krymsk® 99 is tolerant
- Densipac & Replantpac are tolerant



Peach orchard management is Labor Intensive

Pruning, thinning, harvesting

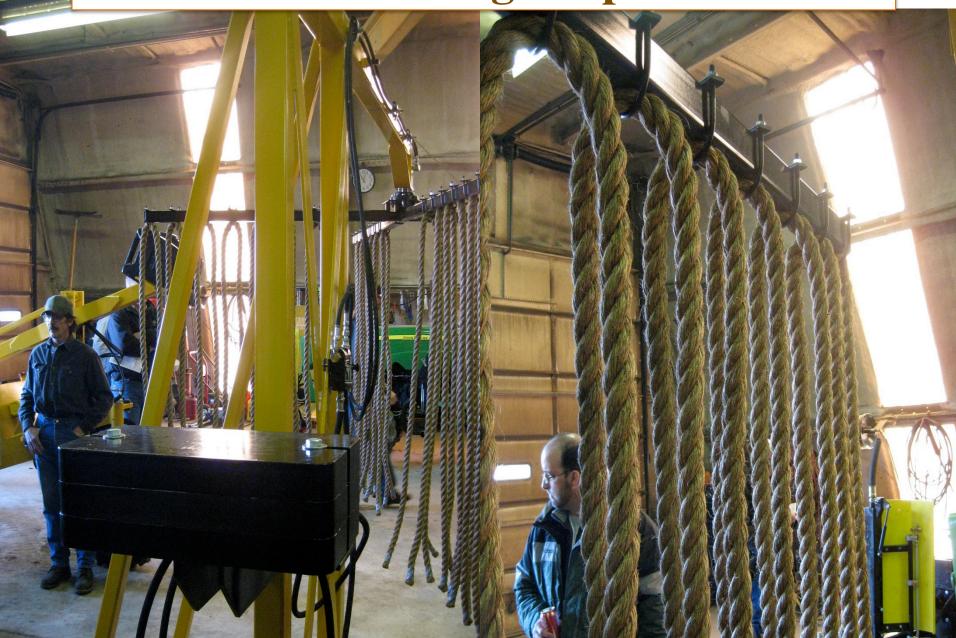




Chemical Thinning Agents

- Dormant oils (vegetable oils)
- ATS (nitrogen fertilizer or herbicide)
- Wilthin (caustic acid, has label)
- Tergitol (surfactant)
- Lime sulfur (5 to 6 gal./100 gal. water)
- Crocker's Fish Oil (3%)
- Dormex (hydrogen cyanamide)
- Armothin (surfactant, 3%)
- Ralex or Release LC (GA3)

Mechanized thinning: Rope thinners







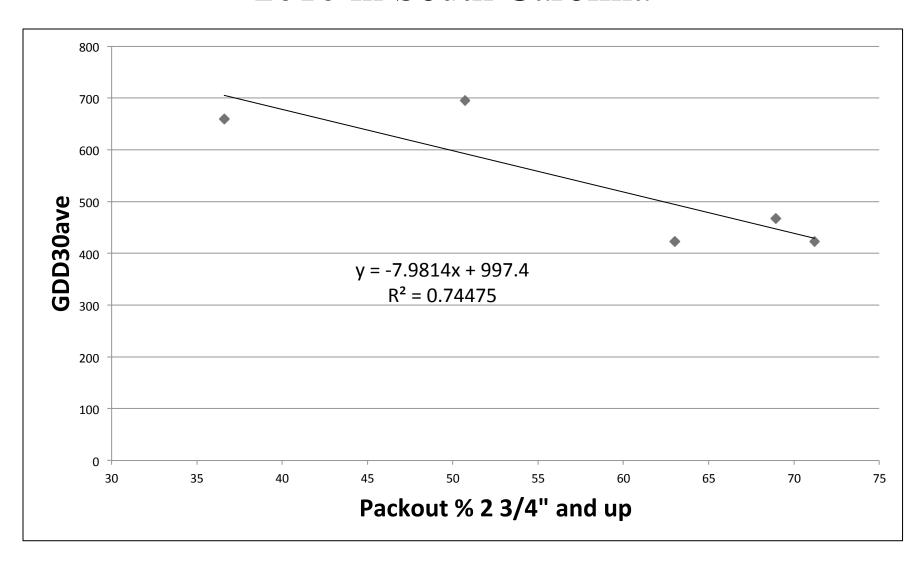


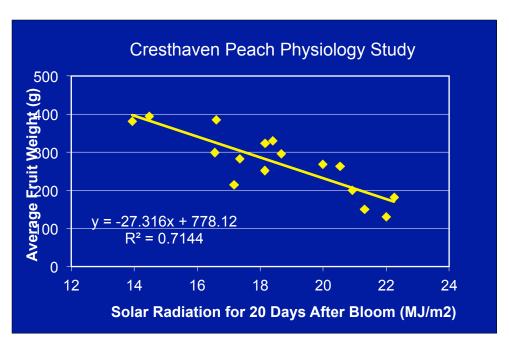


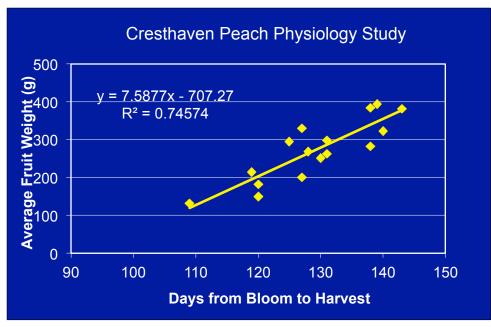
Peach RGR, GDD30, Fruit Size & Maturity

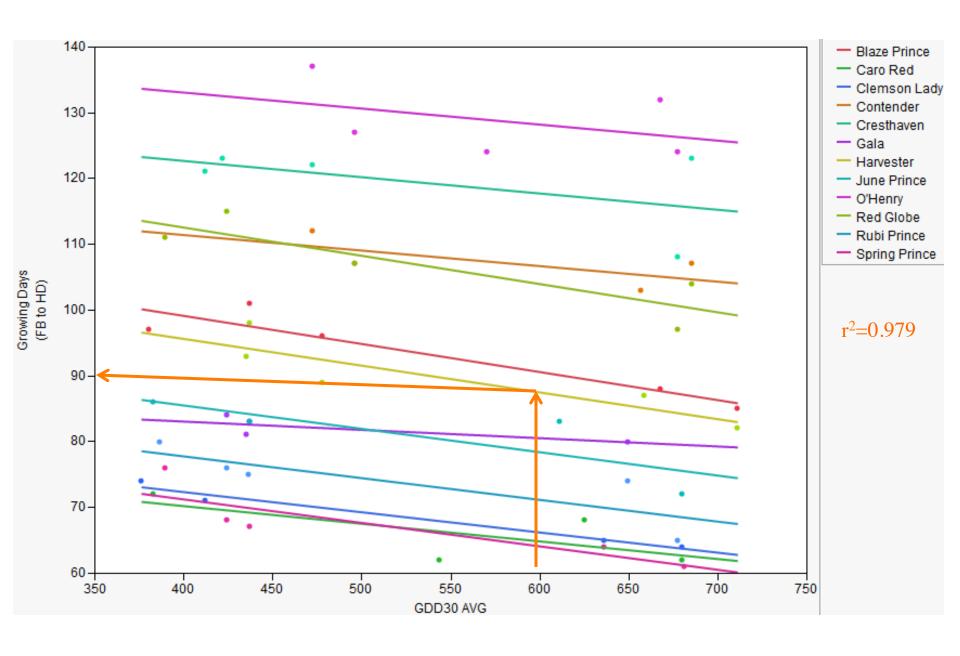
- Peach fruit growth potential can be efficiently described by relative growth rate (RGR). http://fruitsandnuts.ucdavis.edu/Weather_Services/Harvest_Prediction_About_Growing_Degree_Hours/
- Growth potential that is not realized in a given interval cannot be regained later (i.e., no compensatory dry weight growth).
- RGR explains interactions between crop load and fruit size and has strong implications for fruit thinning practices: i.e., early thinning can increase fruit size and yield.
- Factors that speed up rates of fruit development also increase the fruit growth potential for defined time periods. Thus, since high spring temperatures strongly influence rates of fruit development they can result in smaller fruit sizes and less yield for a given crop load (this is also a likely explanation for why large fruit sizes in some warm climates are hard to achieve).
- Factors that slow down rates of fruit development extend the period of time that the plant has to supply potential fruit growth demands (carbohydrates, water, minerals) and thus can lead to larger fruit size and yield (e.g., high nitrogen effects).

Sum of GDD 30 Days after Bloom and % Packout of >30 Peach Varieties for 2002, 04, 05, 08, and 2010 in South Carolina







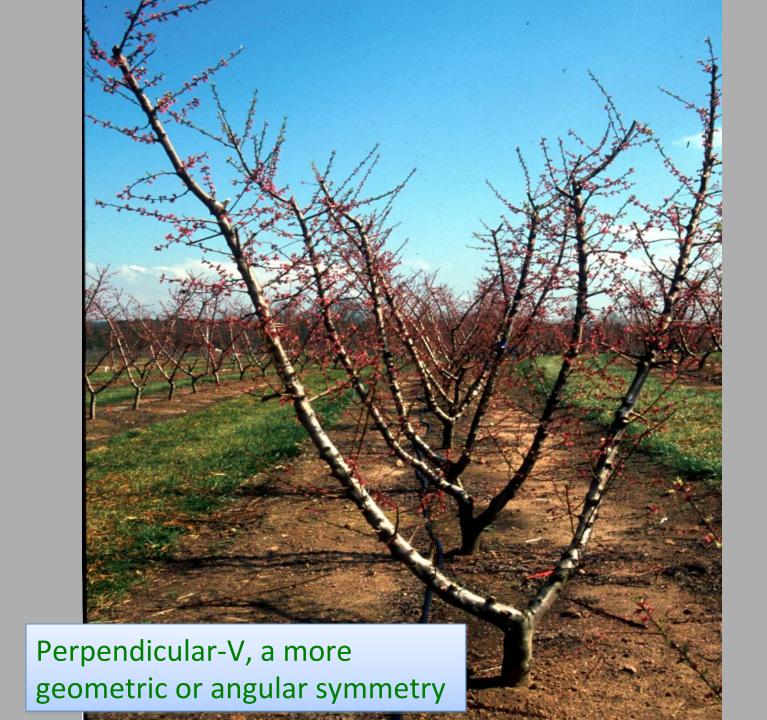




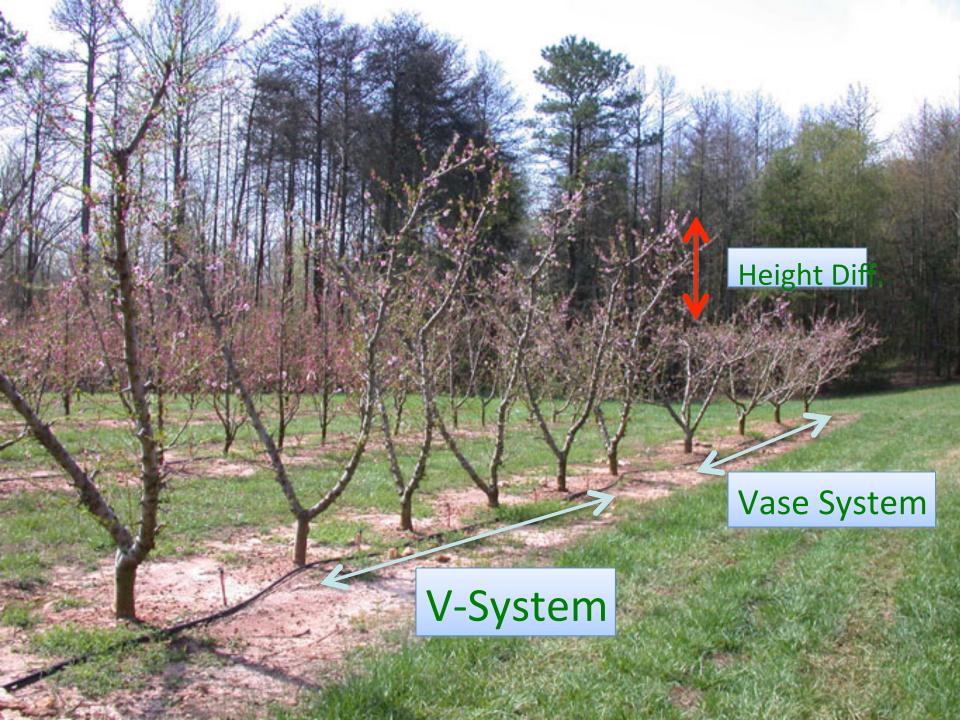
Training Systems

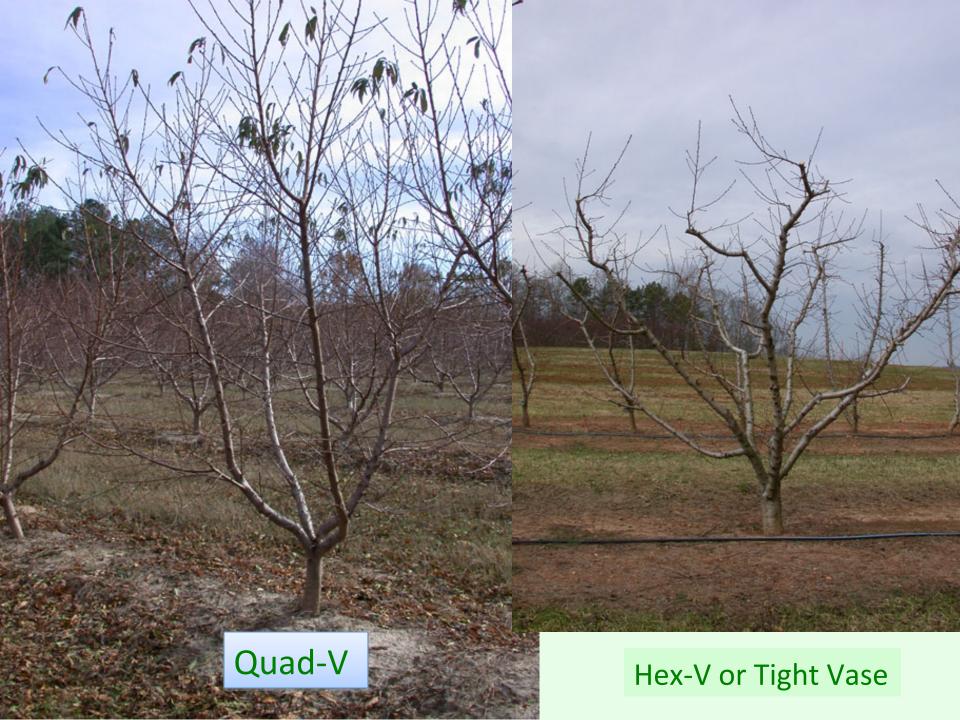
- Open center or vase
- Tight vase
- Perpendicular V or Y
- Quad V



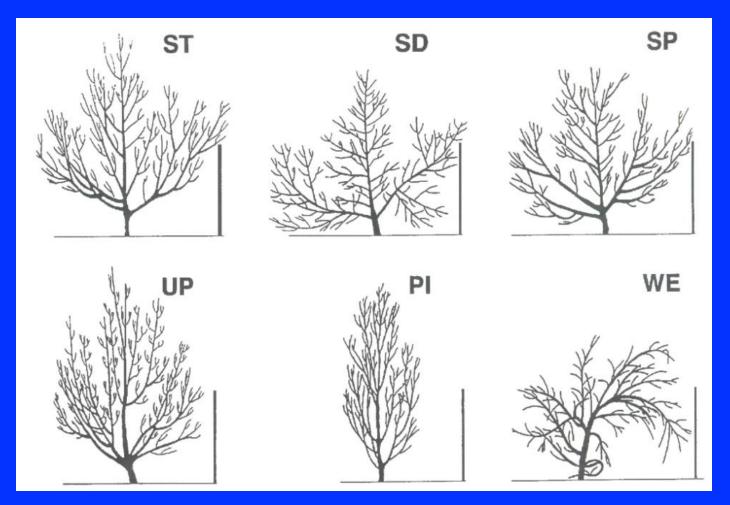




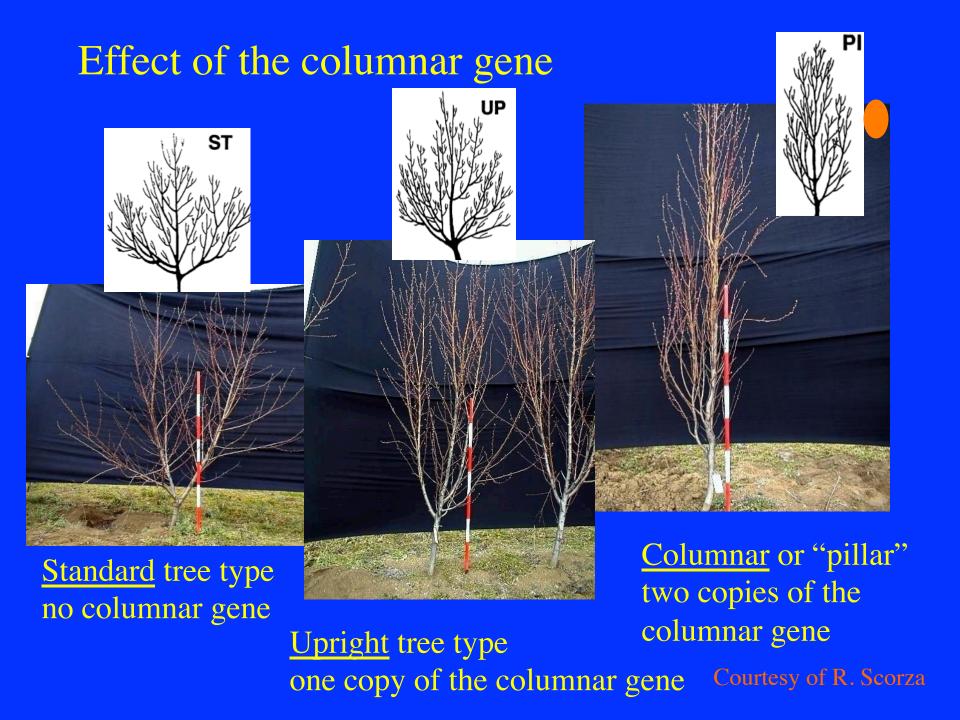


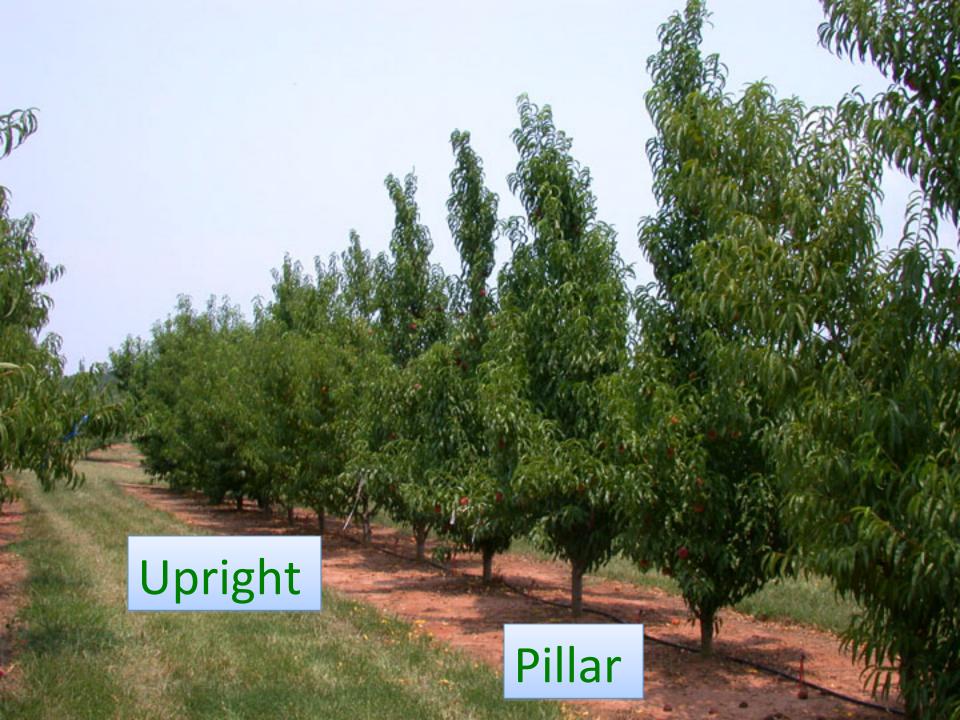


In addition to training schemes, peach genetics provide an array of growth forms.



Courtesy of R. Scorza





COLUMNAR and UPRIGHT TREES

- narrow canopy suited to high density tree wall and spindle systems
- fruit readily harvested from narrow canopy
- suited to harvesting with mechanical aids





California Perpendicular-V Processing Peach on Lovell





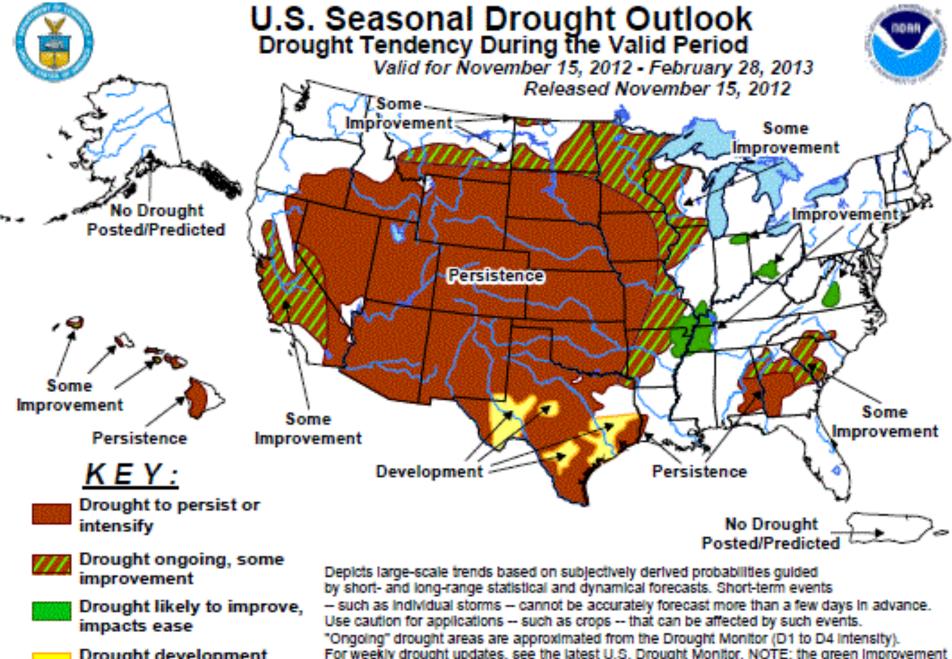
Semi-Dwarfing Rootstocks (70-95% of Lovell Peach)

- HBOK 50 (= Controller 9.5) (95%)
- Controller 9 (90%)
- Penta and Imperial California (90%)
- HBOK 10 (= Controller 8) (80%)
- HBOK 32 (= Controller 7) and MP-29 (75%)
- HBOK 27 (= Controller 6) (70%)
- Controller 5 interstem (70%)
- Pumiselect® (70%)
- Nanopac (70? %)

Dwarfing Rootstocks (<70% of Lovell Peach)

- Krymsk® 99 (65%)
- Krymsk®1 (60%)
- Controller 5 (60%)
- Sharpe (60%)
- Wavit (60%)
- Rigatano (60%)
- Densipac Rootpac® 20 (60%)





For weekly drought updates, see the latest U.S. Drought Monitor. NOTE: the green improvement Drought development areas imply at least a 1-category improvement in the Drought Monitor intensity levels, likely but do not necessarily imply drought elimination.

Microsprinklers vs. Point Source Emitters



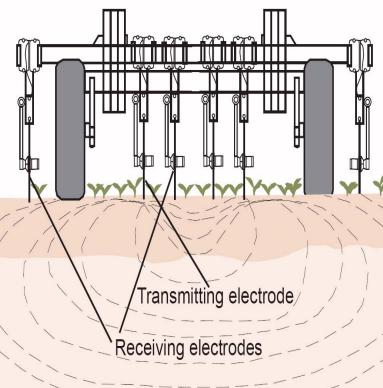


- Fewer heads needed to cover large areas
- 2 to 3° frost protection possible
- Use on a less frequent basis means that herbicides last longer
- Less affected by wind if lines lay on the ground
- Less water loss to evaporation
- Better for use in heavier soils having a low infiltration rate

Field Soil Mapping

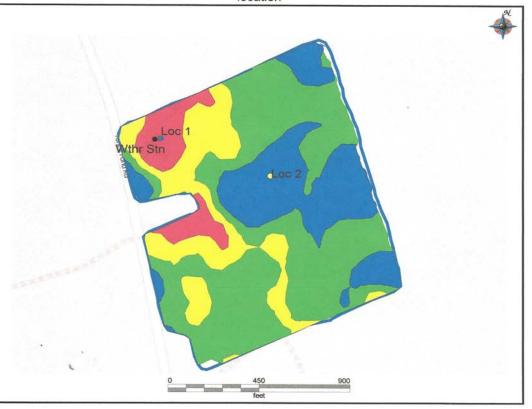


Veris 3100 Soil EC Mapping System



Courtesy: Veris Industries

Irr Orchard - 2011 Peach: Scouting location



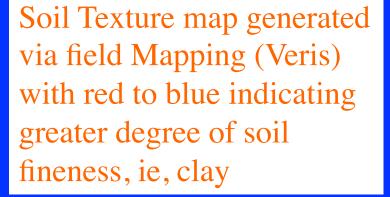
Client: < Unassigned Client > Loc 1
Field: Irr Orchard Loc 2
Crop: 2011 Peach
Name: sensor loc_pts

Loc 1

Loc 2

Wthr Stn

Name: sensor loc_ Type: Scouting Area: 36.20 ac Date: 3/15/2011



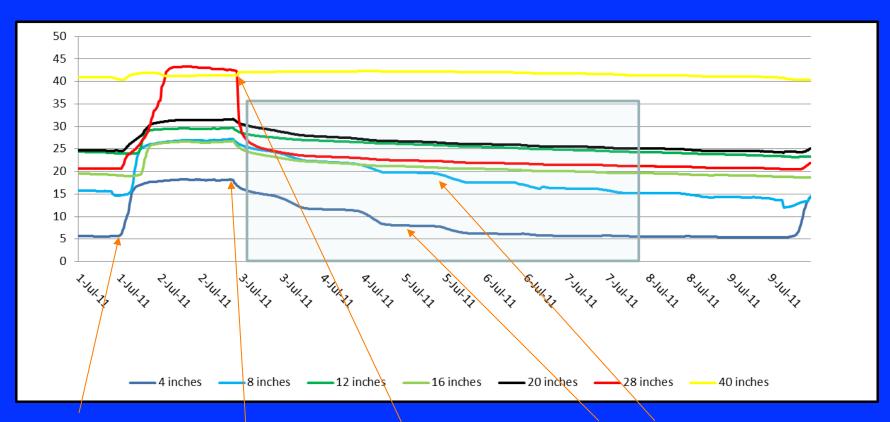








Irrigation Events



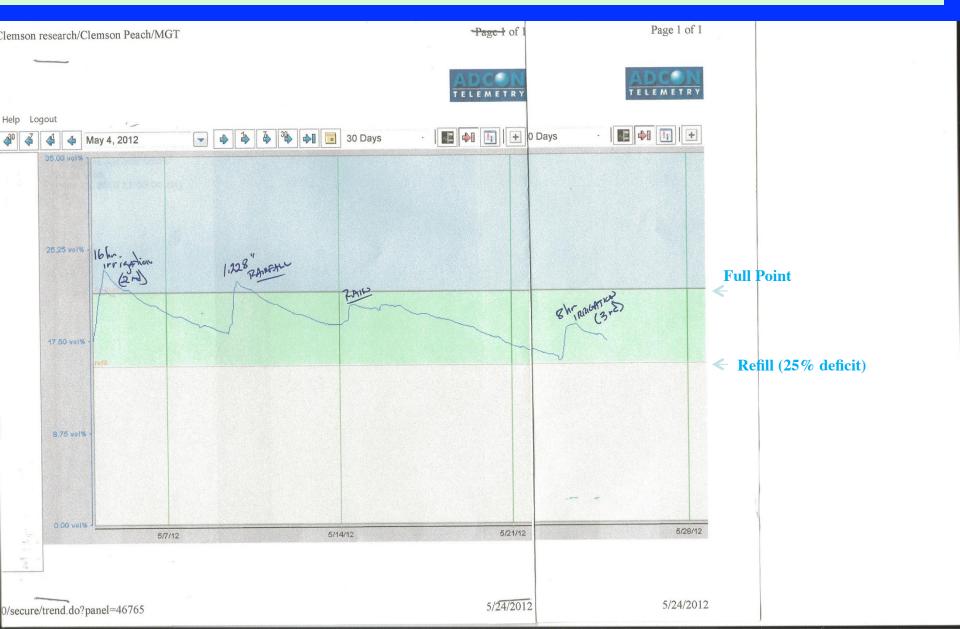
Start of irrigation

Water depletion over time

End of irrigation

Maximum depth to which water penetrated (40 inches)

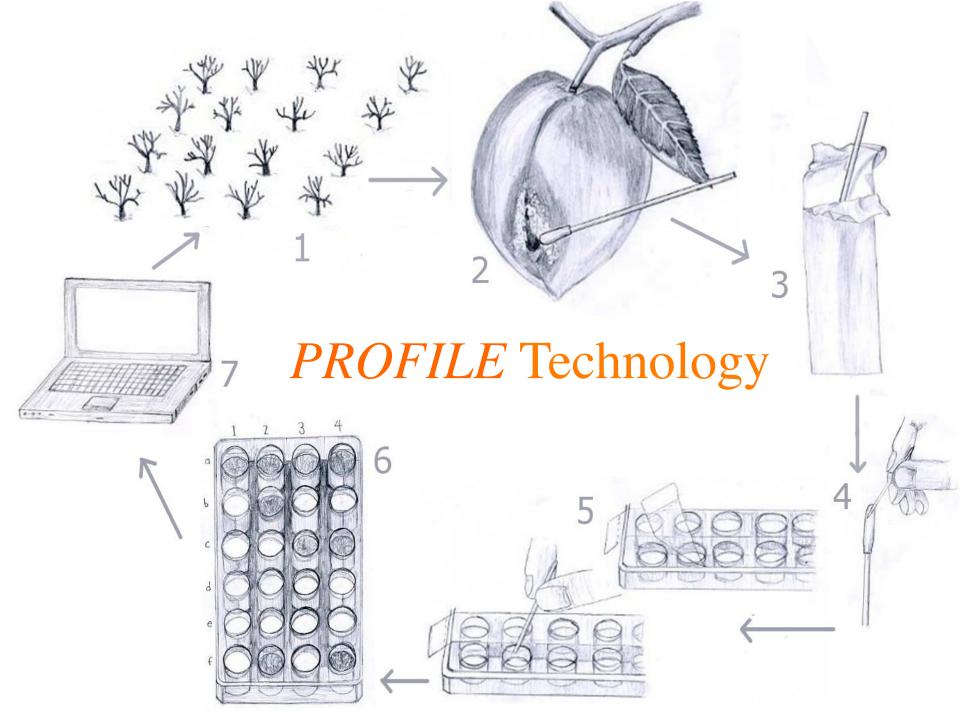
Sensor driven irrigation Scheduling



Disease management: Brown rot of peach is an ideal candidate for resistance

- Large populations and rapid multiplication of target pathogen
- **Extensive and concentrated areas of use**
- Use of repetitive or sustained treatments









Clemson University Extension Service

1. General considerations for brown rot resistance management

All fungicides utilized for brown rot management should be incorporated into a spray program guided by resistance management strategies. In the absence of resistance, specialists recommend that pre-harvest fungicides be utilized in alternation which incorporate numerous (at least two) modesof-action classes. Early-season and cover spray fungicides should generally incorporate chemistries which are unlikely to develop resistance (i.e. chlorothalonil [Bravo and generics], captan, and sulfur products) or which can not be utilized later in the growing season (i.e. iprodione [Royral], cyprodinil [Vangard], etc.). In the absence of resistance, the currently recommended blossom blight and brown rot management strategy is shown below (Figure 1). The schematic also indicates the preferred timing for each of the chemical classes.



* if DMI resistance is suspected or documented, use captan instead of sulfur in cover sprays and use high rate of Elite or Indar preharvest

Figure 1: Recommended resistance management strategy in the absence of resistance to any currently utilized fungicidal class. Where two or more compounds are mentioned, such as during bloom, only one of the materials need to be utilized. In the cover sprays, sulfur materials provide scab control and acceptable brown rot suppression during dry years, but when conditions are wet or other summer diseases are a problem, captan products are much more effective. Likewise, captan can be utilized at the first preharvest application (21 days prior to harvest), but Pristine is more effective if rainfall is prevalent.

2. Your personalized recommendations based on the data you entered The resistance factor for DMI fungicides is 24.3 indicating medium resistance

Due to the absence of effective alternatives, DMI fungicides should still be used for preharvest brown rot control. In contrast to the benzimidazoles, however, DMI fungicides still work well against DMI-resistant populations if the rate is increased. Use Elite 45DF, Indar 2F, Indar 75WSP, or their generics at double the normal rate (highest allowable label rate). For Elite that would be 8 ozacre, for Indar 2F it would be 12 fl ozacre, and for Indar 75WSP it would be 4 ozacre (rates are state specific for Indar products; check to confirm that this rate is legal in your state). Do not use DMI fungicides more than once per season if possible (not during bloom and again if possible, only once during the pre-harvest season). Especially since resistance has developed to the DMI fungicides, make sure to utilize Pristine (high rate) at the 14 days before harvest window, and a DMI fungicide should not be utilized until 7 days before harvest.

The resistance factor for MBC fungicides is 48.6 indicating high resistance

Do not use benzimidazole fungicides, such as Topsin-M or Thiophanate-Methyl, for at least the next two growing seasons, and use the Profile kit to confirm that resistance is no longer present before

using again. The exclusive use of other chemical classes will significantly reduce the presence of benzimidazole-resistant M. fructicola populations and over time you can expect benzimidazoles to work again, but a reversion to a susceptible fungal population may take several years.

The resistance factor for QOI fungicides is 72.9 indicating high resistance

Resistance to Abound and at least one of the active ingredients in Pristine (pyraclostrobin) has developed. Discontinue use of Abound at this time. Still, we recommend that you use Pristine 14 days before harvest and as needed to complete your spray program. Use the high dose. We continue to recommend Pristine because the other component of Pristine (boscalid) is the much more active material in the product. Do not use Pristine more than necessary during the growing season (do not use for bloom or cover sprays and use it sparingly during the pre-harvest season). At this time, use the Profile kit to carefully monitor the boscalid component of Pristine, as it will likely develop resistance soon as well.

The resistance factor for DICARBOX fungicides is 243 indicating high resistance.

Resistance to Royral was detected. We recommend to not use this product during bloom for blossom blight control for the next 2 years

The resistance factor for Pristine fungicides is 243 indicating high resistance.

Resistance to Pristine has developed. Discontinue use of Pristine at this time. Over time, the fungal population may revert back to susceptibility to boscalid, but the Profile kit should be utilized to check before Pristine is utilized again for brown rot management; a brown rot control failure could easily result if Pristine is used again too soon.

3. Other resistance-related things to consider

Products containing more than one active ingredient should not be used in locations with demonstrated resistance issues to either chemical class:

-Adament contains a DMI (tebuconazole) and a QoI (trifloxistrobin) fungicide and should not be used in locations with documented medium to high DMI or QoI resistance.

If resistance is observed to more than one chemical class, a consultation with a state specialist will be required to determine the best course of action. With each Profile submission, an automated response will be sent to your state specialist, so he/she should have the information required to help you with your particular situation. Please contact your county extension agent, and they will initiate a consultation with your state specialist. Use at least 100 gal water/acre to get adequate coverage. Brand names of fungicides are provided in the advisory as a convenience to the grower. They are neither an endorsement of the product nor a suggestion that other products with the same active ingredient are not effective.

4. Disclaimer

The recommendations, results, and data contained in this report are provided "as is" without warranty of any kind either express or implied, including without limitation the implied warranties of merchantability and fitness for a particular purpose.

Recommendations are based on information from the manufacturer's label and performance data from research and extension field tests. Actual results may vary based on environmental conditions, grower application methods, and other factors. These recommendations do not imply that performance of fungicides will always conform to the safety and pest control standards indicated by experimental data. Always read the pesticide label before making any application.



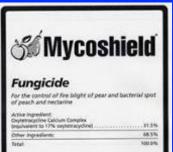
Bacterial Spot on Green and Ripe Fruit



Chemical Sprays

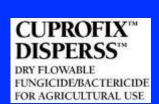


Antibiotic (oxytetracycline)



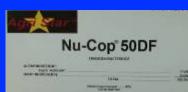


Some Representative Brands and Formulations of Copper-Containing Fungicides/Bactericides







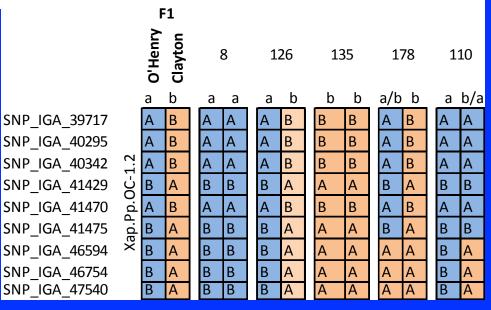


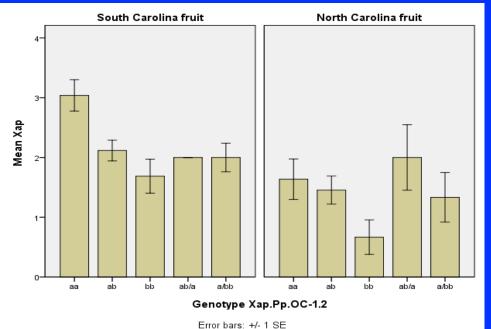


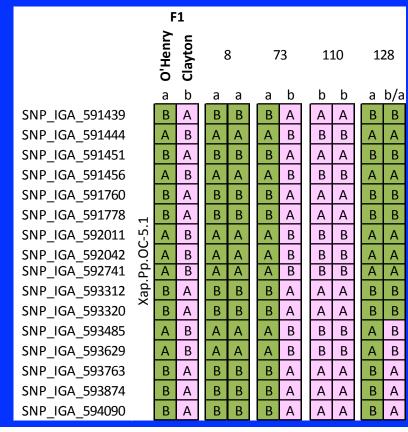


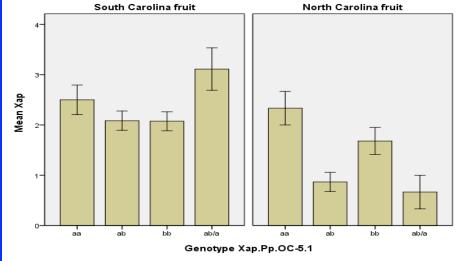


Haplotyping









Error bars: +/- 1 SE

New Pests of Peach



Kudzu Bug



Brown Marmorated Stink Bug



2-Lined Japanese & White Fringed Beetles

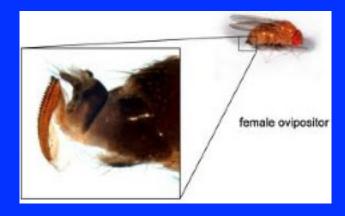




Spotted Wing Drosophila (SWD)













Stone Fruit Pest Management in California







Scouting for stinkbugs

Yellow pyramid traps baited with *Euschistus* spp. pheromone are very effective for monitoring Brown & Dusky Brown stink bugs



Yellow pyramids are a poor method for sampling other stink bugs and relatives to include Green & Southern green stink bugs or Leaf footed bugs







Horton & Cottrell



Monitoring OFM







Mating Disruption of Oriental Fruit Moth



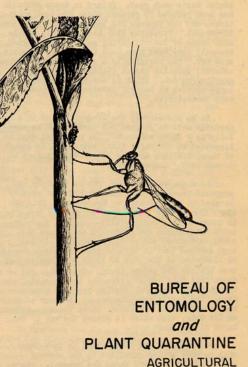






EC-3

HOW TO USE PARASITES against the ORIENTAL FRUIT MOTH



RESEARCH ADMINISTRATION
U.S. DEPT. of AGRICULTURE

APRIL 1948

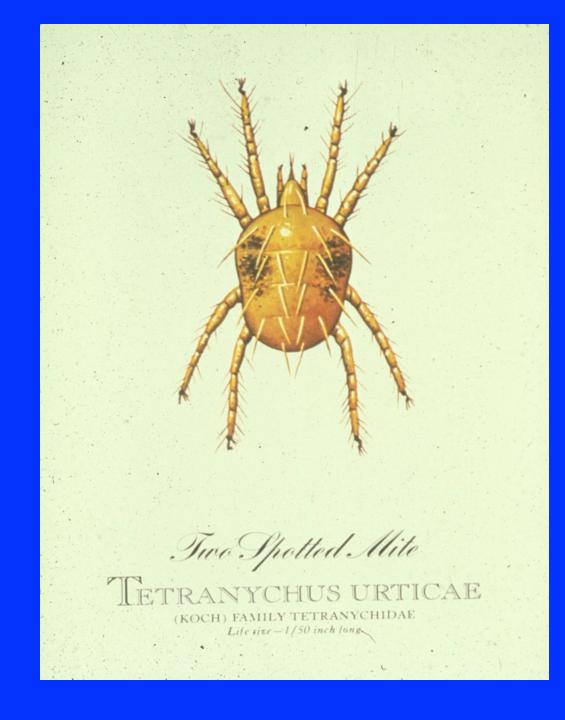
Parasitoid Introduction



Mites

Increased Use of
Pyrethroids has
Elevated Mites
from Occasional
Pest Status to
Every Year Pests
in Occasional
Blocks

Rotating curative miticides & spraying asneeded is the best option in peaches



Viruses











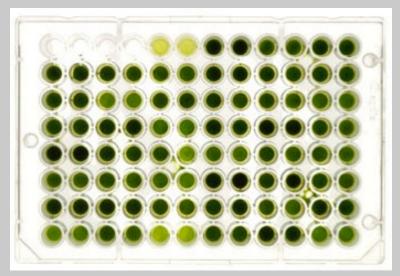




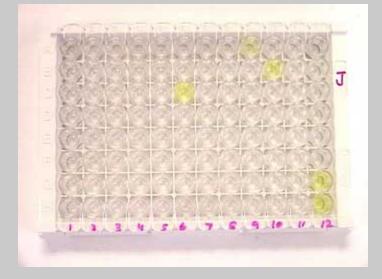
ELISA Test



B



C



[Simon Scott]



Chalmers Carr, Titan Farms								Rubyprince	
			Field	B5-1					
			1 1010						
	1	1558	1559	1574	1575		1590		
	1	1557	1560	1573	1576	1589	1591		
	İ	1556	1561	1572	1577	1588	1592		
	1	1555	1562	1571	1578	1587	1593		
	1	1554	1563	1570	1579	1586	1594		Missing
	1	1553	1564	1569	1580	1585	1595		Missing Tree
	İ	1552	1565	1568	1581	1584	1596		1100
	1	1551	1566	1567	1582	1583	1597		
		*							
GPS co-ordinates N 33.51.476							Cample	d April 4, 2012	
W081.44.364							Sample	u April 4, 2012	
									Virus-infected
	Plum Pox virus was not detected in any of these trees								tree
	Prune dwarf virus was not detected in any of these trees								
	Prunus nec	rotic ri	ngspot	virus w	as det	ected in	n tree:		
				1597					
	All tests were completed using ELISA								
									CIEMSON
									U N I V E R S I T Y
									<u>U N I V E R S I T Y</u>
									Simon Scott

Some Genetic Tests for Peach Available Now







Fruit Skin Color

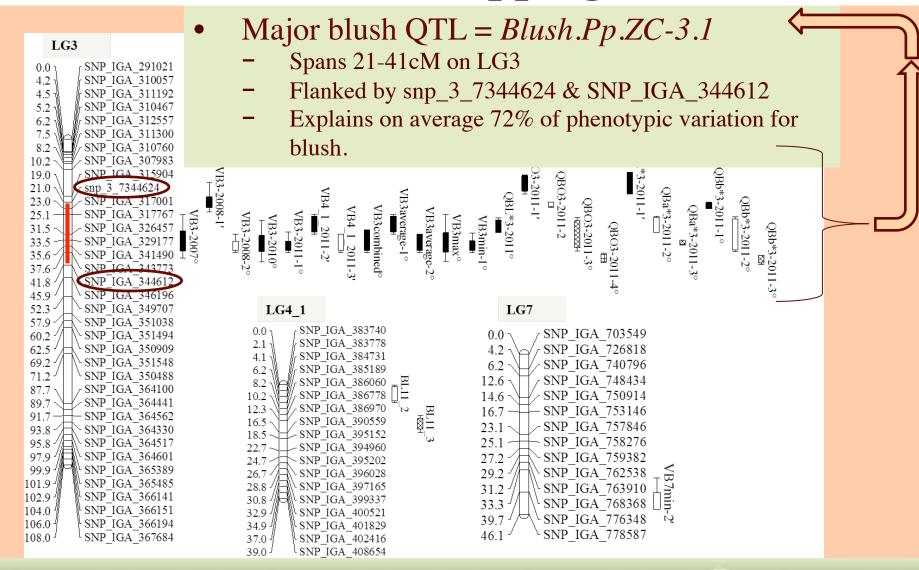








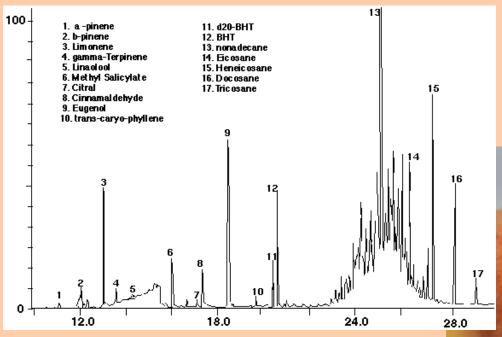
QTL Mapping

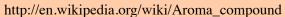


www.rosbreed.org

Rosbream Resisted breeding in Rosaceae

Traits 4 Fruit Flavor

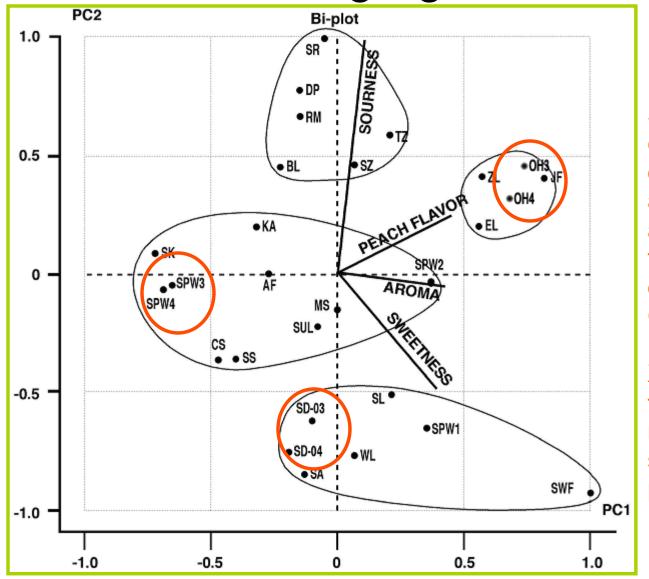








Peach Segregation



Segregation of 23 peach cultivars originating from different breeding programs according to their sensory attributes as perceived by a trained panel and determined by Principal Component Analysis (PCA). PC1 (44%) is plotted on the X-axis and PC2 (33%) on the Y-axis with the vectors representing the loadings of sensory data along with the principal component scores.

Crisosto, C.H., **G.M.** Crisosto, **G.** Echeverria, and **J.** Puy. 2006. Segregation of peach and nectarine (*Prunus persica* (L.) Batcsh) cultivars according to their organoleptic characteristics. Postharvest Biology and Technology 39:10-18.



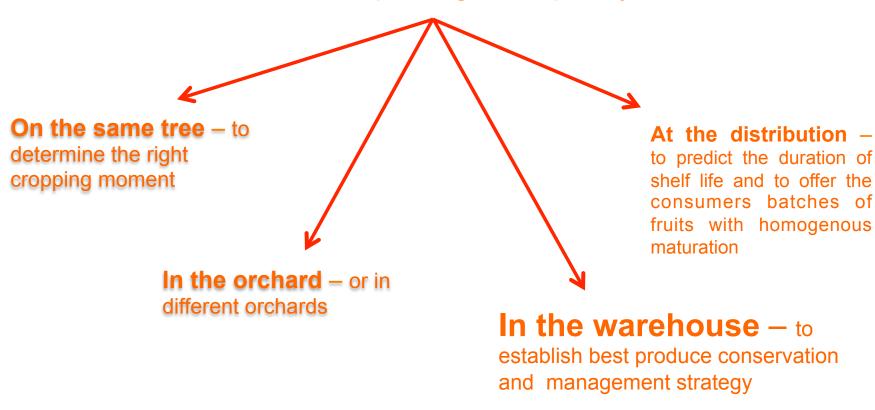






DA Meter to measure peak ripeness for each variety

The DA hand-held device allows monitoring of evolution of fruit ripening and quality



Consumer acceptance/evaluation of fruit classified according to IAD index

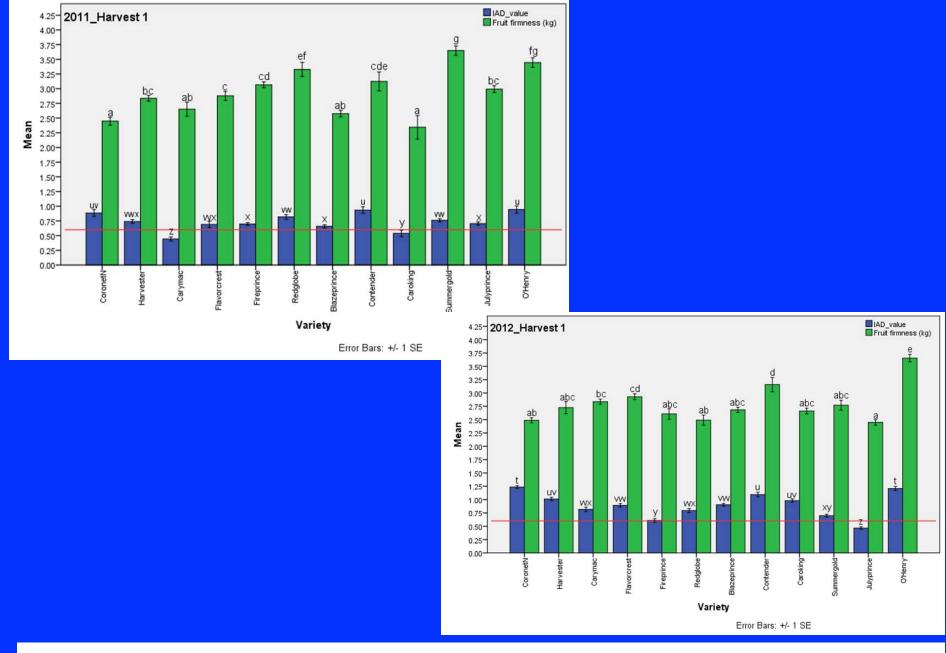
							
Parameters	Class 1	Class 2	Class 3	Class 1	Class 2	Class 3	
	1.1-0.8	0.7-0.4	<0.3	1.1-0.8	0.7-0.4	<0.3	
	E	Blazeprince)	Harvester			
Overall likeness	3.2	3.9	3.7	3.1	3.9	3.9	
Color	4.5	4.5	4.4	4	4.8	4.4	
Firmness	3.5	3.3	3.3	2.8	3.1	4	
Sweetness	2.9	4.3	3.3	3	3.8	3.8	
Taste	2.8	3.6	3.8	3	4.1	3.8	
Satisfaction	3	3.9	3.8	3.3	4.1	3.9	
Purchase?	2.6	3.8	3.8	2.7	3.4	3.5	

Scores: 1 – do not like to 5 – like very much

Consumer survey

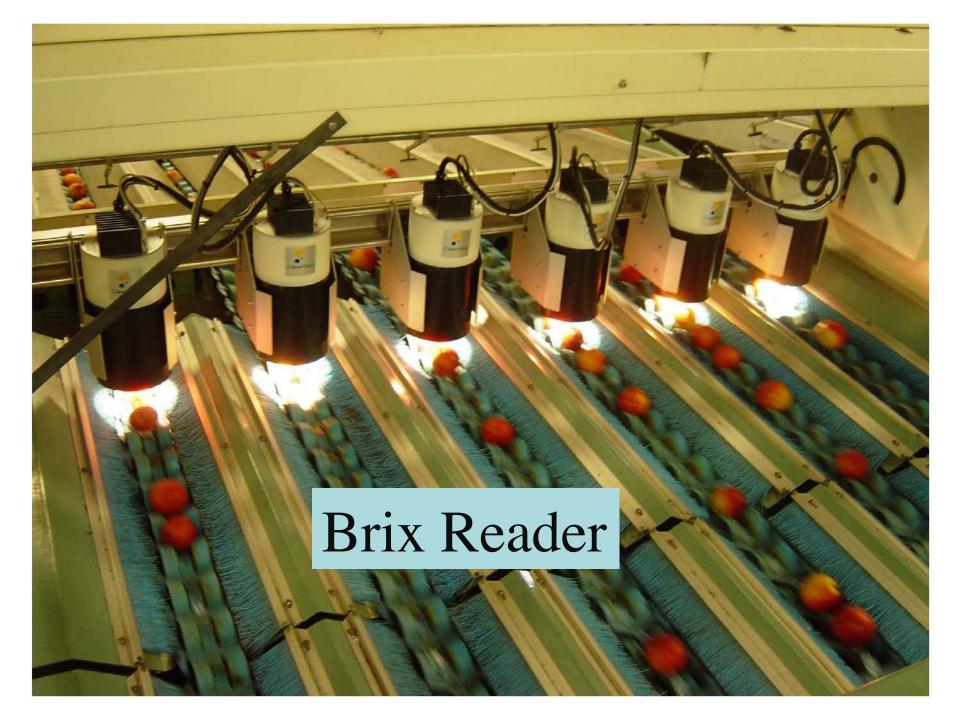
- The three classes of Blazeprince and Harvester peaches were differentially appreciated by the consumers.
- They expressed a higher degree of overall likeness for classes 2 and 3 than for class 1.
- This difference was translated into a higher desire of the consumer to buy fruit from classes 2 and 3 than those from class 1.





Different letters indicate significant differences at P<0.05 (Student-Newman-Keuls's test) Red line depicts maturity level (≤ 0.6) appreciated most by consumers.

















Pat's Pride

TREE RIPENED

WAXED

































































SAVE THE STONE FRUIT! AVOID THE KILLING TEMPERATURE RANGE.

Postharvest Control



Stone Fruit Ripening

PROPER TEMPERATURE GUIDELINES
FOR CALIFORNIA
PEACHES • PLUMS • NECTARINES

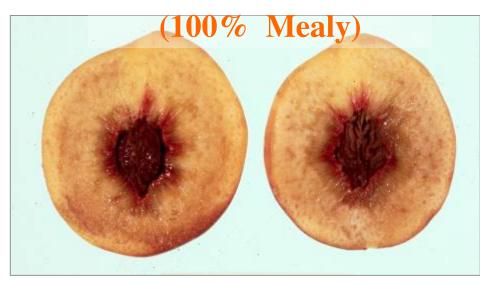
PEACHES • PLUMS • NECTARINES

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Peach Delayed Cooling

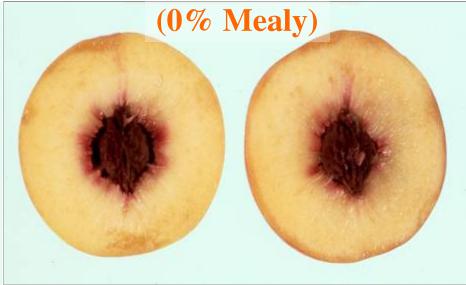
Crisosto, Carlos H., David Garner, Harry L. Andris, and Kevin R. Day. Controlled delayed cooling extends peach market life. HortTechnology 14:99-104.



5°C 20 Days



0°C 20 Days



20°C 48 Hours + 5°C 20 Days

"Nothing's Fresher, Nothing's Finer"



Thank you! Questions?