



Pomegranates



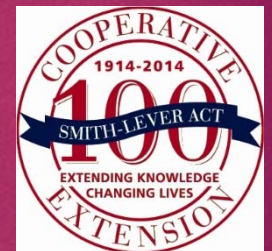
The Arizona Story

Glenn C Wright, University of Arizona



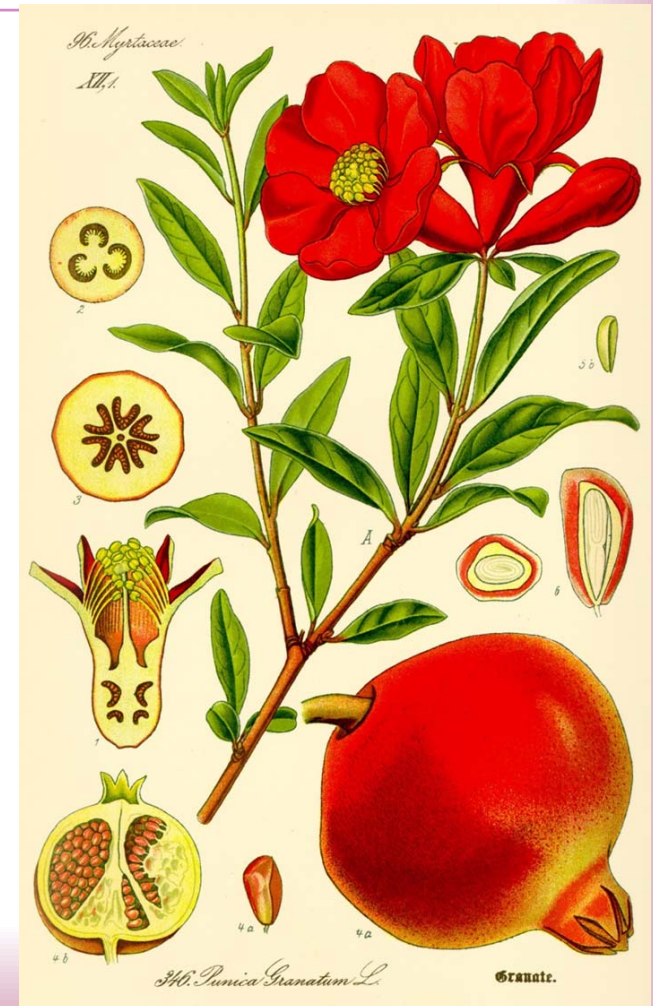
AGRICULTURE
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COOPERATIVE EXTENSION
Yuma Agricultural Center



Pomegranates – The Arizona Story

- ❧ History and Arrival in the State
- ❧ Mission Heritage Fruit Tree Project
- ❧ Commercial Industry
- ❧ Experimental Work
 - ❧ Rationale and Objectives
 - ❧ Establishment
 - ❧ Challenges
 - ❧ Results
- ❧ Issues at each location



Granada Spain

Granada's historical name in the Arabic language was غرناطة (Ġarnāṭah) – “Hill of Strangers”



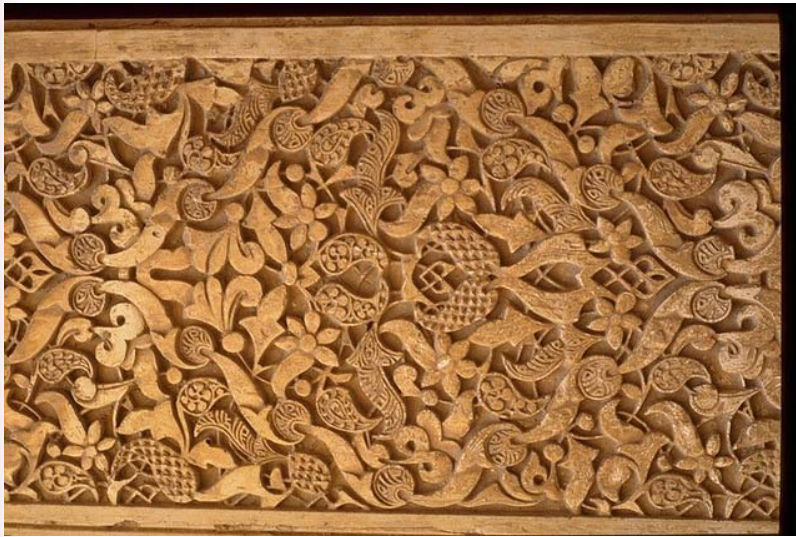
Granada Spain



Palaces and Gardens



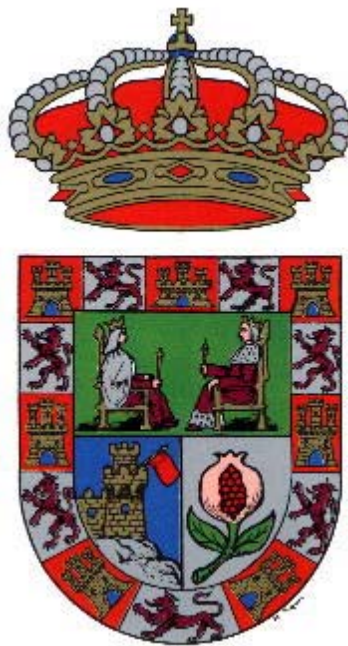
Islamic and Modern Art



Coats of Arms



City of Granada

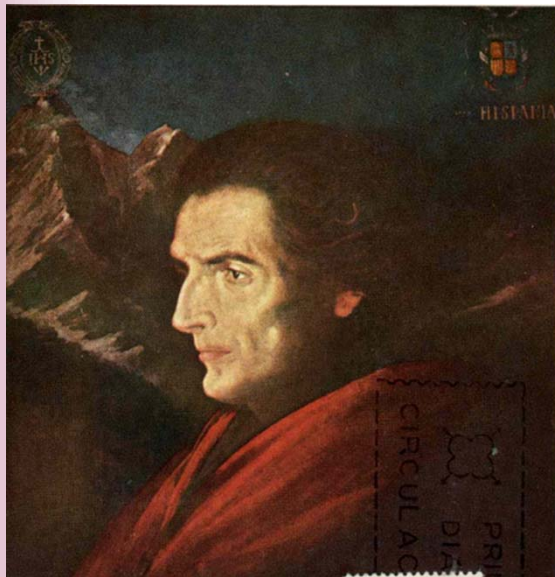


Kingdom of Spain





They finde quinces in all the country of the Indies, and in New Spaine, in such abundance as they gave vs fifty choice ones for halfe a riall. There is great store of pomegranates, but they are all sweete, for the sharp are not there esteemed.



- The Natural and Moral History of the Indies by Father Jose de Acosta (1590), English translation by Edward Grimston (1604).

Pomegranates in New World Art

Incense Burner, Bolivia,
19th Century

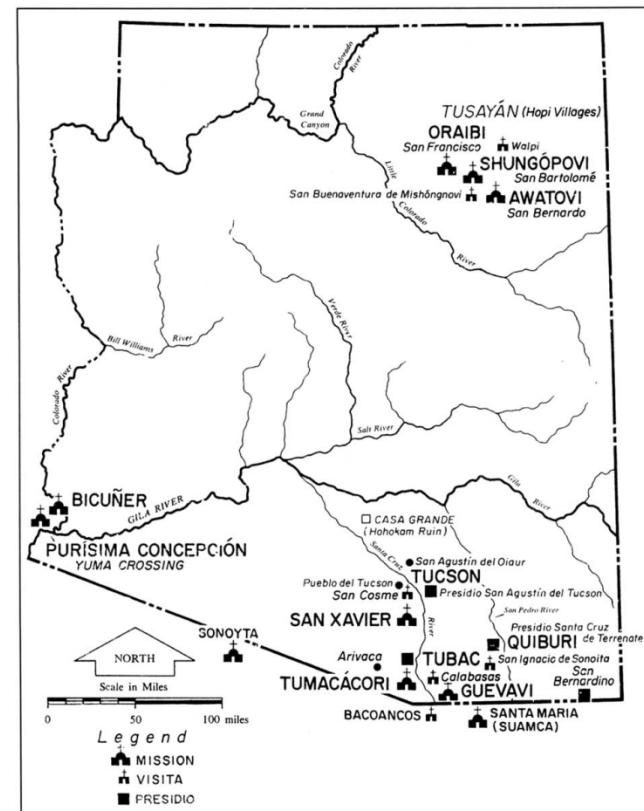


Wool on cotton embroidery, Mexico, mid 19th Century



Spanish Missions in Arizona

- ✧ In the Spring of 1687, a Jesuit missionary named Father Eusebio Francisco Kino lived and worked with the native Americans in the area called the Pimería Alta, or "Upper Pima Country," which presently is located in the areas between the Mexican state of Sonora and the state of Arizona in the United States.
- ✧ During Father Eusebio Kino's stay in the Pimería Alta, he founded over twenty missions in eight mission districts in Arizona,



Spanish Missions in Arizona

Mission San Cayetano del
Tumacácori - 1691



Mission San Xavier del Bac -
1692



Spanish Missions in Arizona

- ❧ Europeans at the missions tried to eat foods that were familiar to them.
- ❧ Mission policy required neophytes to integrate European crops into existing native agricultural practices. Bluntly stated, they should eat like Christians.
- ❧ Mission inhabitants resisted this demand by complementing their mission diets with foraged foods consumed in private residences.
- ❧ Remains of acorns, seeds, fruits, fish, shellfish, waterfowl, and game have been found in mission residential structures from Florida to California.



Spanish Missions in Arizona



Kino—"El Caniblanco"

✧ "This mission has his church adequately furnished with ornaments, chalices, cups of gold, bells, and choir chapel; likewise a great many large and small cattle, oxen, fields, a garden with various kinds of garden crops, Castilian fruit trees, grapes, peaches, quinces, figs, pomegranates, pears, and clingstones..."

--Father Eusebio Francisco
Kino, Dolores 1695

Mission Heritage Fruit Tree Project

- ❧ The objective is to reproduce the oldest known heirloom fruit trees in southern Arizona and northern Sonora and Baja California.
- ❧ Another objective is to possibly find trees that were grown by Spanish missionaries who first introduced them to the region in the 1680's.
- ❧ Includes an assortment of pomegranates, figs, quince, plum, guava and mission grapes.
- ❧ Some of the original trees have persisted on private properties, while others have been found growing in wild, riparian areas.



Directors: Jesús Manuel García-Yáñez, Arizona-Sonora Desert Museum & Robert M. Emanuel, University of Arizona

Mission Heritage Fruit Tree Project

- ❧ Sosa Carrillo - A delicious soft-seeded Pink pomegranate, that appears to have been originally grafted onto a white pomegranate, planted in 1880's in Tucson
- ❧ Ruby - White pomegranate found near spring near ghost town of Ruby near Border, Santa Cruz County
- ❧ Josefina - White pomegranate from Tucson, extremely sweet with white fruit
- ❧ Quitobaquito - White pomegranate from the iconic Quitobaquito Springs in Organ Pipe National Monument
- ❧ Edgar Canyon - Red pomegranate occurring in a lush riparian area on the east side of the Santa Catalina Mountains



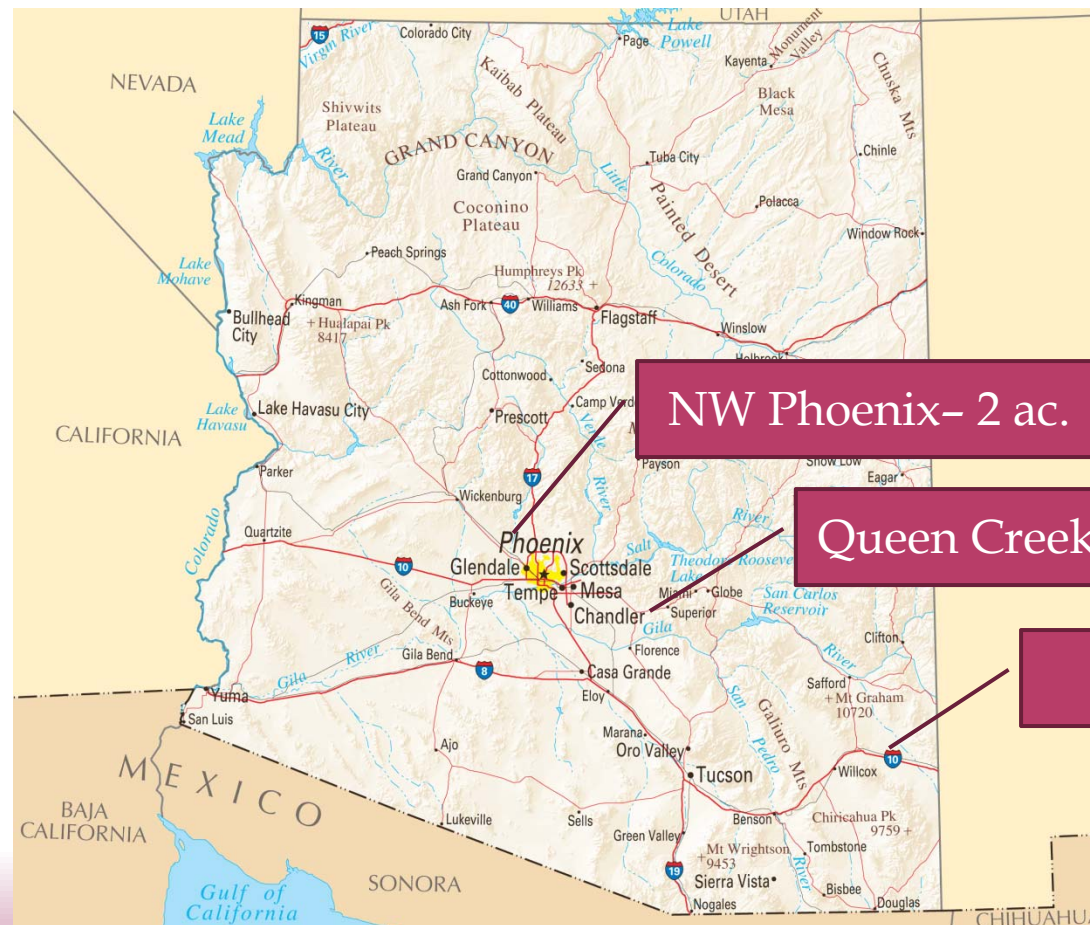
Other Potential Reasons to Plant Pomegranates in Arizona



- ❧ As an alternative to other high-value crops, especially citrus.
 - ❧ Low water use
 - ❧ Nutritious
- ❧ To provide a local source of the fruit to Arizona consumers
- ❧ Potential alternative for landscaping



Commercial Pomegranate Industry in AZ



Turley Pomegranates

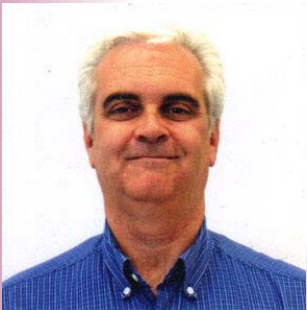


- ❧ 92 total acres
 - ❧ 27 acres of Wonderful, planted in 2009
 - ❧ 25 acres of Angel Red, planted in 2010
- ❧ 3700 feet elevation
- ❧ Climate similar to San Joaquin Valley?

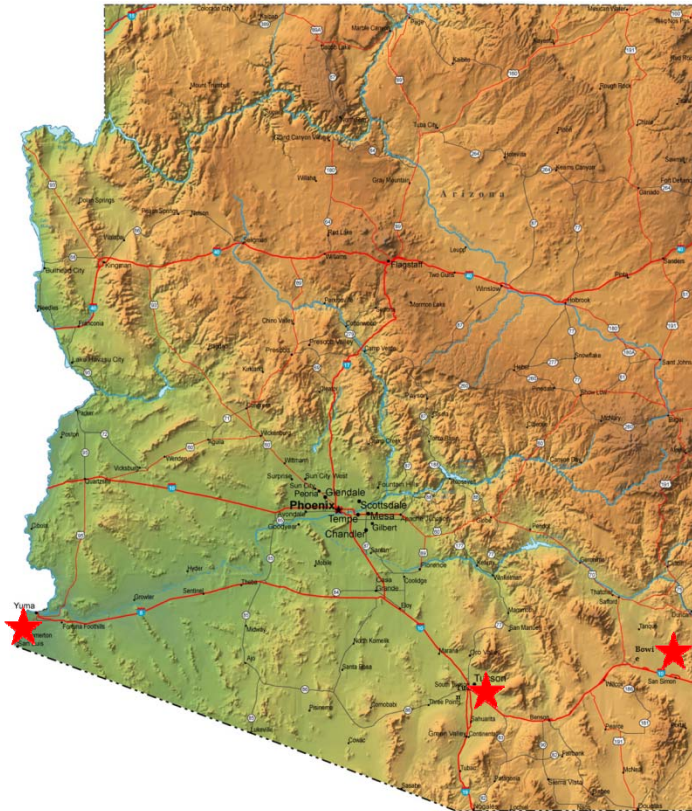


2011 Pomegranate Experiment

- ✧ Investigators: Ursula Schuch and Glenn Wright
- ✧ Objectives:
 - ✧ To test 28 varieties (now 32) of pomegranate for their suitability at three different sites: Southwest Arizona, near Yuma, Southern Arizona near Tucson, and Southeast Arizona in Cochise County.
 - ✧ At each site, plants will be evaluated for plant growth, precocity, yield and fruit quality.



Three Sites



❧ Yuma

- ❧ 164 Feet above sea level
- ❧ Avg. High and Low – 89F and 63F

❧ Tucson

- ❧ 2490 Feet above sea level
- ❧ Avg. High and Low – 83F and 58F

❧ Bowie

- ❧ 3700 Feet above sea level
- ❧ Avg. High and Low – 79F and 48F

Yuma Site July 2012



Tucson Site May 2012



Bowie Site April 2012



32 Varieties

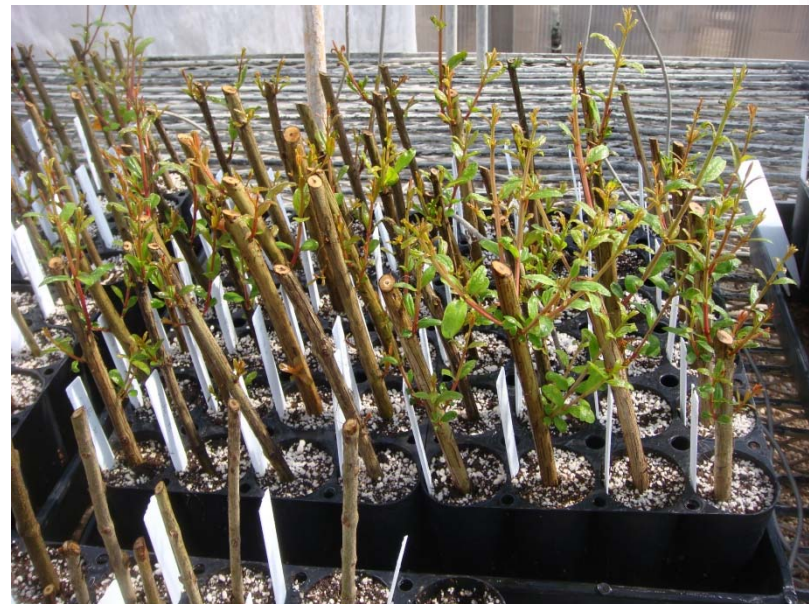


Edible Cultivars	Origin	Edible Cultivars	Origin
Angel Red	California	Purple Heart	California
Ariana	Turkmenistan	Ruby	Arizona
Azadi	Turkmenistan	Sin Pepe	California
Cranberry	California	Sirenevyi	Turkmenistan
Desertnyi	Turkmenistan	Sogdiana	Turkmenistan
Fleischmann's	California	Sosa Carrillo	Arizona
Gissarkii Rosovyi	Turkmenistan	Sverkhramniy	Turkmenistan
Granada	California	Syunt	Turkmenistan
Josefina	Arizona	Vkusnyi	Turkmenistan
Kara Bala Miursal	Turkmenistan	Wonderful	California
Medovyi Vahsha	Turkmenistan	Ornamental Cultivars	Origin
Molla Napes	Turkmenistan	Haku-botan	Japan
Myagkosemyannyi	Turkmenistan	Haku-taka	Japan
Rosovyi			
Nikitski Ranni	Turkmenistan	Ki-Zakuro	Japan
Palermo	Italy	Nochi-shibori	Japan
Pamyati Rozanov	Turkmenistan	Toryu-shibori	Japan
Parfianka	Turkmenistan		

Establishment



- ❧ Hardwood and softwood cuttings received in February 2011 and May, 2011
- ❧ Propagated on Mist Bench
- ❧ Repotted into 15 gallon containers
- ❧ Hardening in lath house
- ❧ Planted in 2012 (approx. 16 x 20 spacing)
- ❧ Randomized complete block with four blocks. One plant per block, 128 plants at each site.



Establishment



- ❧ Irrigation by flood (Yuma), or underground drip (Tucson and Bowie)
- ❧ Fertilization varies by site. N and P applied regularly.
- ❧ Weed control as needed. Tillage, herbicides and hand work used.
- ❧ Plants caged for rabbits in Yuma
- ❧ Plants staked as needed in Tucson.



Harvest



Field Data Collection



Fruit sizer is towed to the field or
fruit is taken to the sizer



Each fruit is photographed,
measured and weighed



Interior Quality Measurements

- ❧ Cut fruit
- ❧ Remove arils
- ❧ Measure and weigh seeds and arils
- ❧ Place arils in press juicer
- ❧ Take °Brix data
- ❧ Titration for acid

Press Juicer



Challenges - Frost



- ❧ Plants in Bowie experienced freezing temperatures from January 12 to 16, 2013
- ❧ Low temperatures were 18F, 9F, 16F, 12F and 13F for the five day period.
- ❧ Little damage to older plants, but significant damage to younger plants.
- ❧ Those plants that were small and had not been irrigated effectively were especially damaged.
- ❧ About 12 of the 128 plants were killed.
- ❧ No significant frost damage in Tucson or Yuma.



Challenges - Wind



- ❧ Significant late summer winds have caused damage to top-heavy plants, especially in Tucson.
- ❧ Plants have been staked and supported.
- ❧ One tree lost in Tucson and one in Yuma.



Challenges - Animals



- ❧ Rabbits damaged young shoots in Yuma.
- ❧ Plants were caged in response.
- ❧ Ground squirrels caused significant damage in Tucson, and less damage in Yuma.
- ❧ Bait was applied to the fields in response.



Challenges – Hail



- ❧ Bowie fruit damaged by hail in August 2015.
- ❧ Many fruit damaged to the point of grade loss.



Challenges – Leaf footed plant bug - *Leptoglossus zonatus*



traps are available, but expensive.

Challenges – Leaf footed plant bug leads to infestation with *Aspergillus* and *Alternaria* fungus



Leaf footed plant bug control



Challenges – Splitting



- ✂ Perhaps due to uneven watering?
- ✂ Split damage more susceptible to damage from leaf footed plant bug.
- ✂ Splitting appears to be less of a problem as trees age.



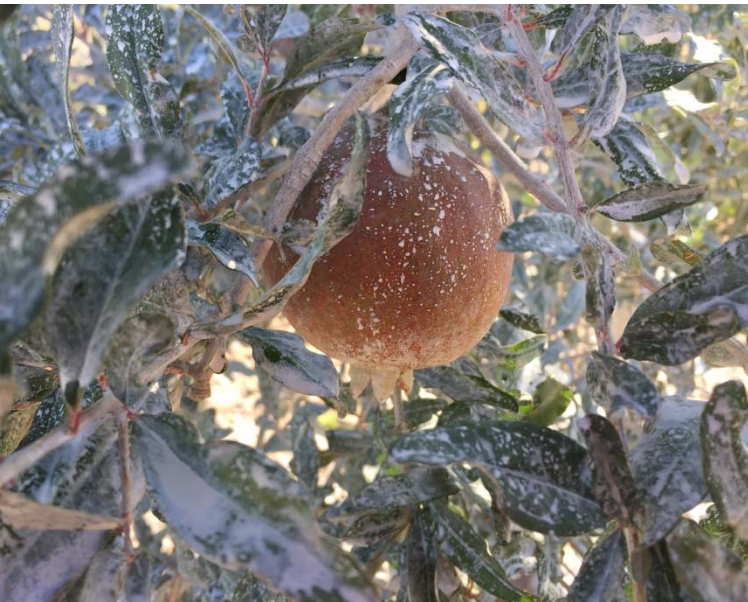
Challenges - Sunburn



- ❧ Especially a problem in Yuma and Tucson.
- ❧ Worse on the south and west side of the plants.
- ❧ Kaolin (Surround) will reduce damage.
- ❧ Most effective in Yuma, less so in Tucson.
- ❧ Plants netted in Yuma



Challenges - Sunburn



Challenges - Sunburn



Israeli Trellis
system



Challenges – Lack of flowering

- ❧ A problem in Yuma, and less so in Tucson.
- ❧ Due to lack of winter chill hours?

Site	<65	<60	<55	<50
Tucson (8/1 - 10/29)	273	140	22	0
Bowie (8/1 - 10/10)	313	115	45	10
Yuma (8/1 - 11/18)	312	140	47	8



Challenges – Lack of Interior Color



A problem in Yuma and Tucson. Due to high heat or lack of chill?

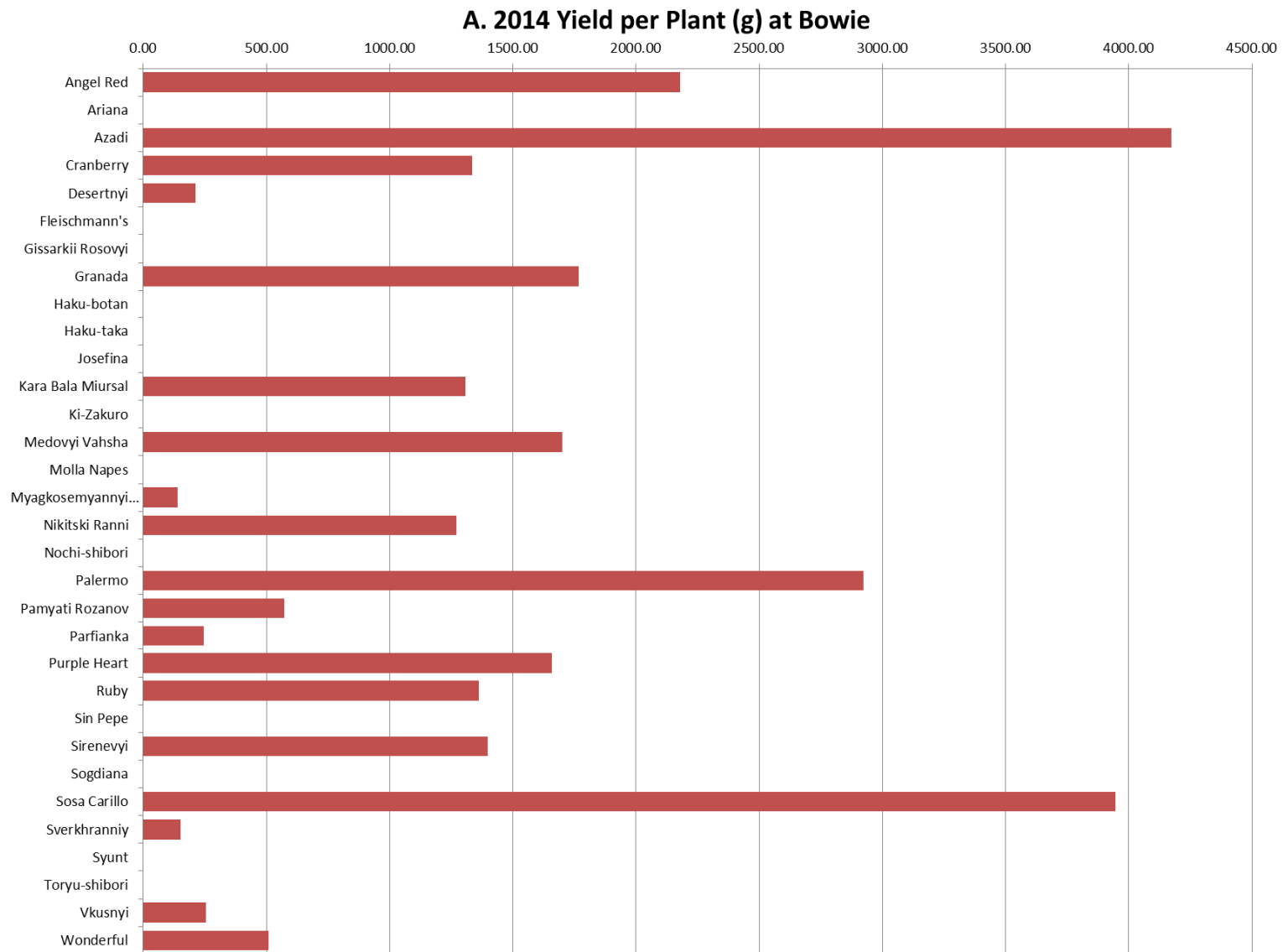
Results – Growth and Flowering (2013 and 2014)



Location	Total Plants	Max. height (m)	Min. height (m)	Mean height (m)
Bowie	116	1.65	0	0.9
Tucson	127	2.19	0.26	1.4
Yuma	127	1.75	0.71	1.2

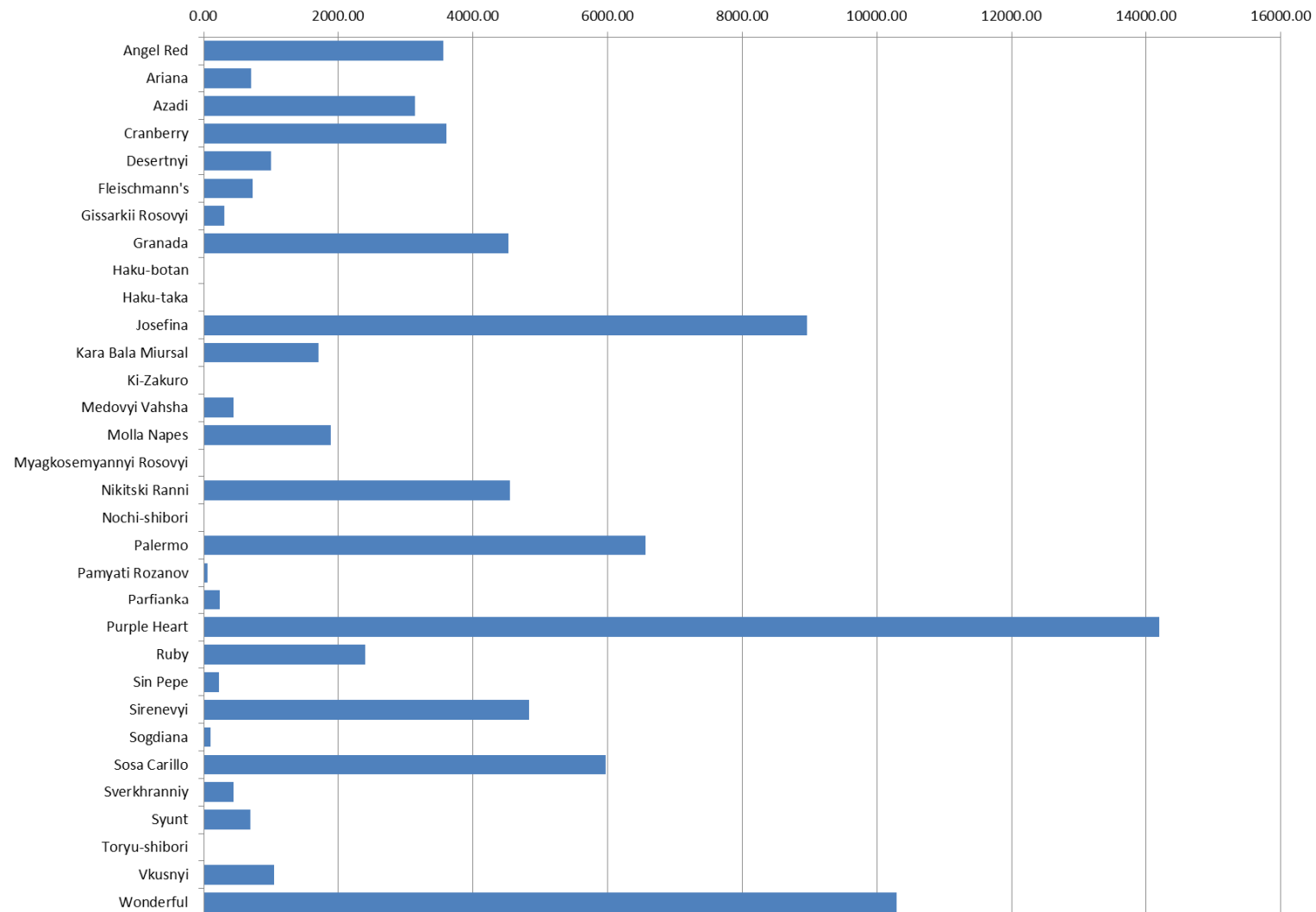
Location	Bud Break	First Flowering	Flowering (% of trees)	Fruit Set (% of trees)
Bowie	3/21 to 4/22	4/22	25	8
Tucson	2/22 to 3/22	4/1	99	91
Yuma	2/5 to 3/5	3/12	68	35

Results – Yield in Bowie



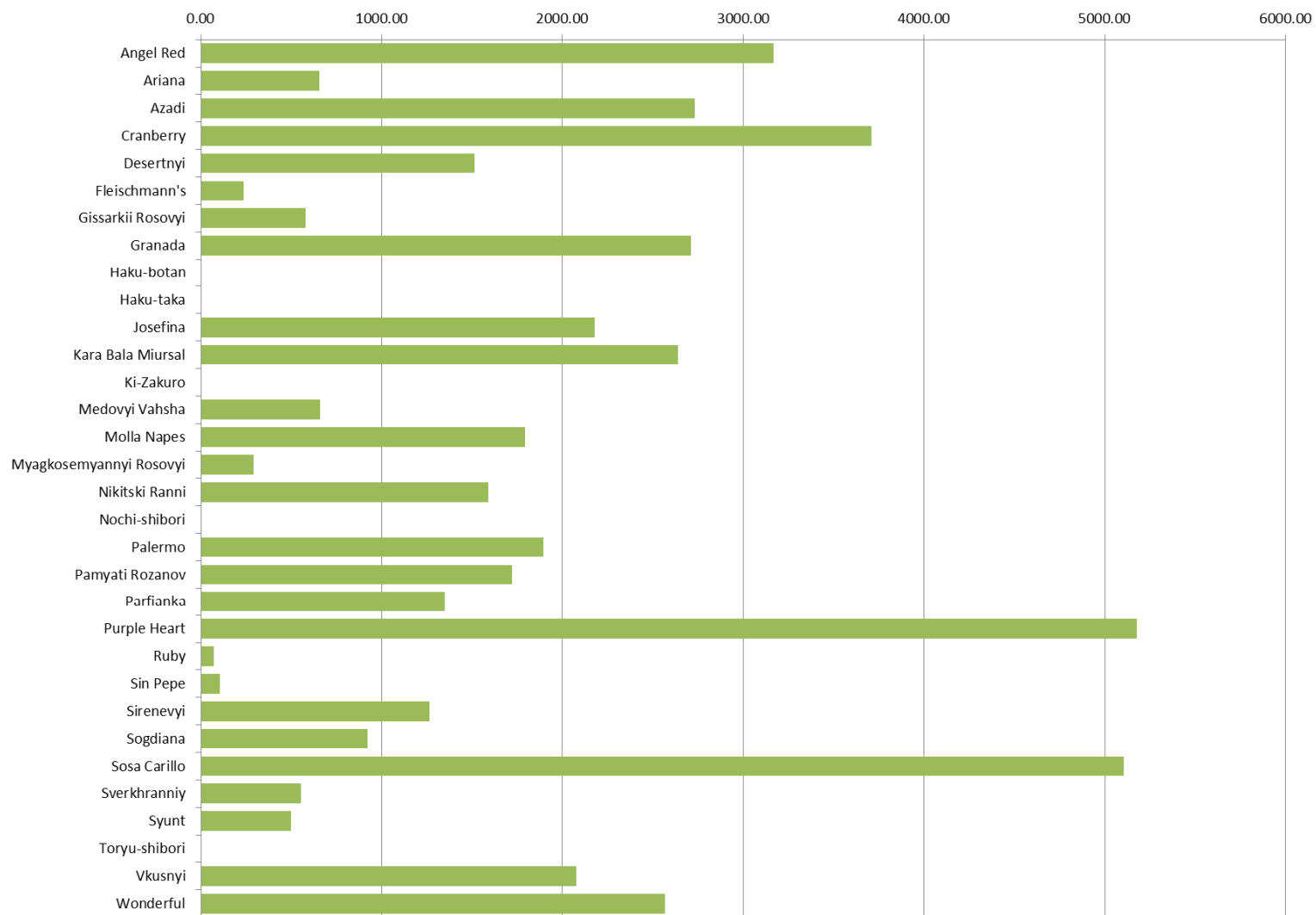
Results – Yield in Tucson

B. 2014 Yield per Plant (g) at Tucson



Results – Yield in Yuma

C. 2014 Yield per Plant (g) at Yuma



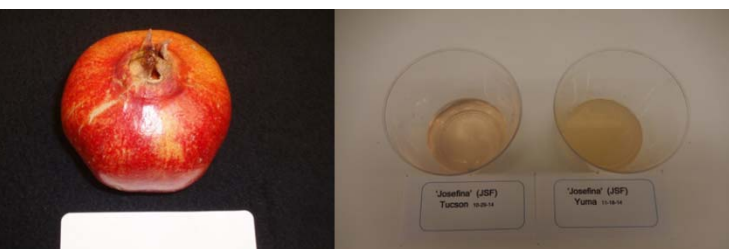
Results – Fruit Quality



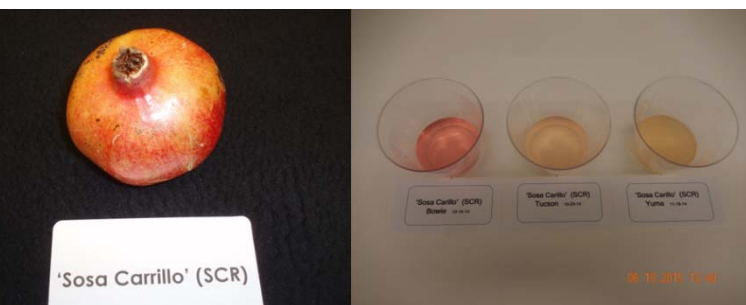
- ✂ % Arils ranges from about 40 to 60%
- ✂ Brix values range from 13 to 18° (Minimum 15°)
- ✂ Brix:Acid ranges from 4 to 15. Fruit with lower values were from Bowie.



Fruit and Juice Appearance



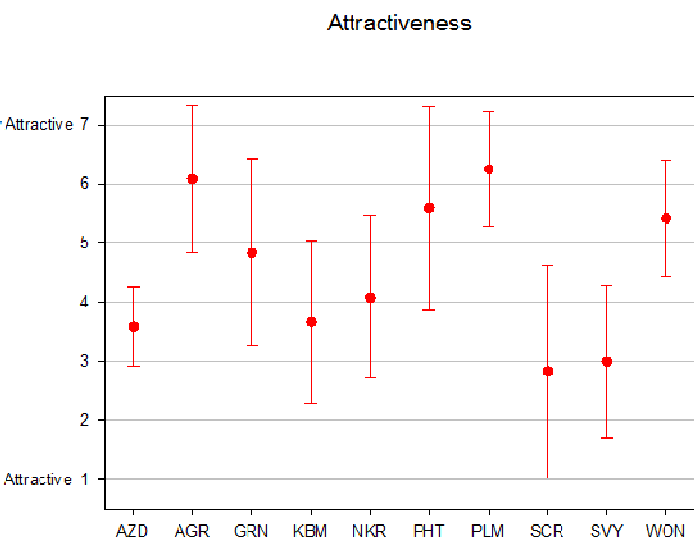
Fruit and Juice Appearance



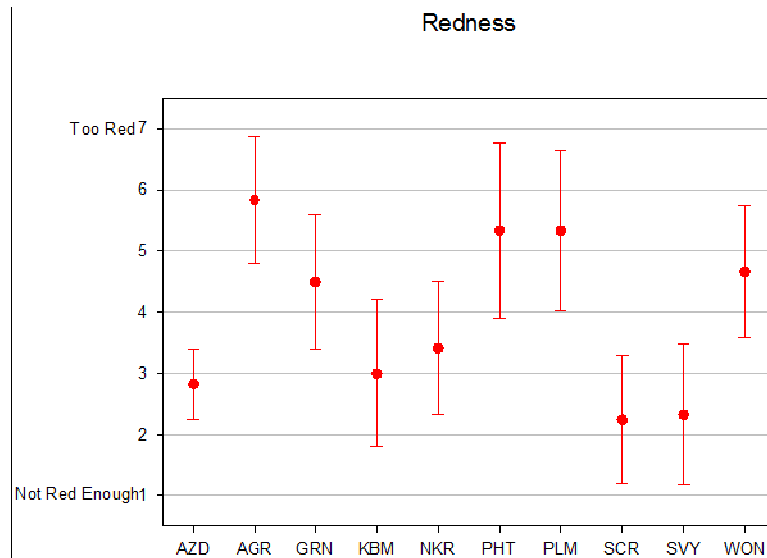
Results – Taste Test



Attractiveness



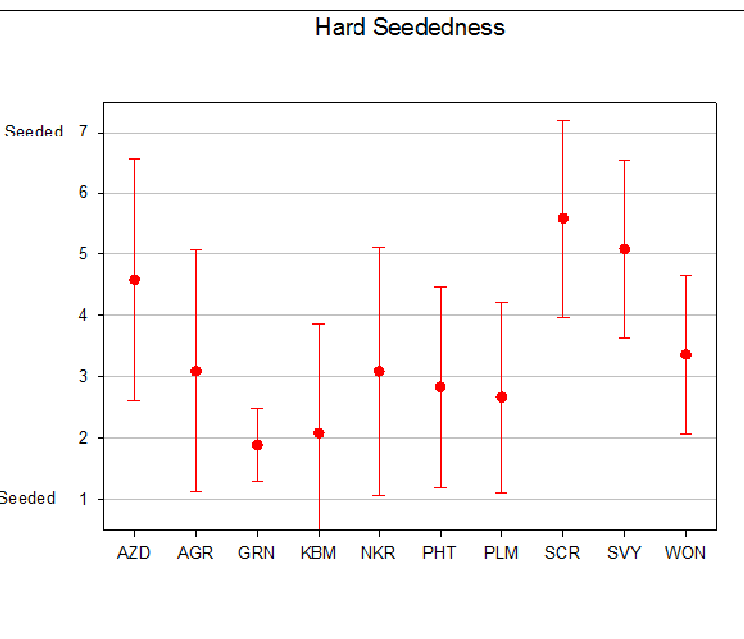
Redness



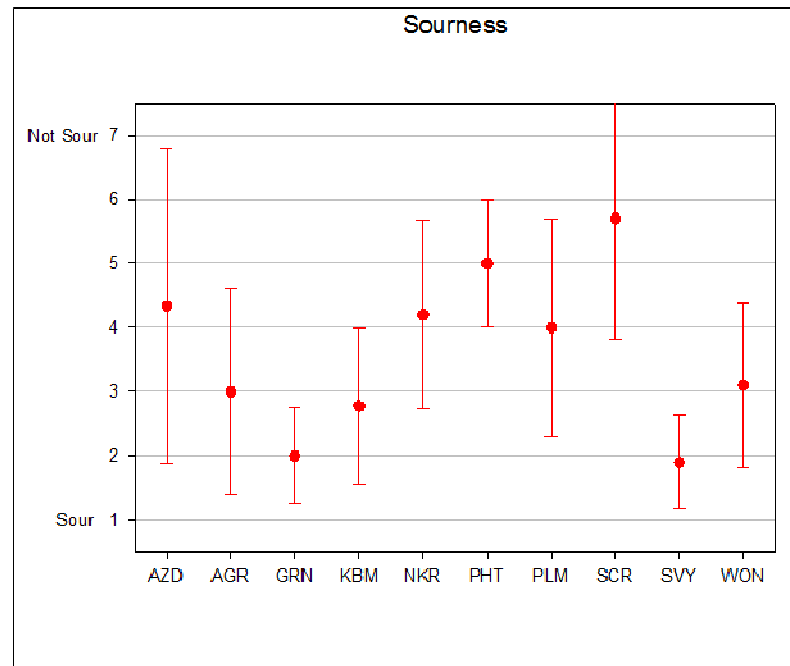
Results – Taste Test



Hard Seededness



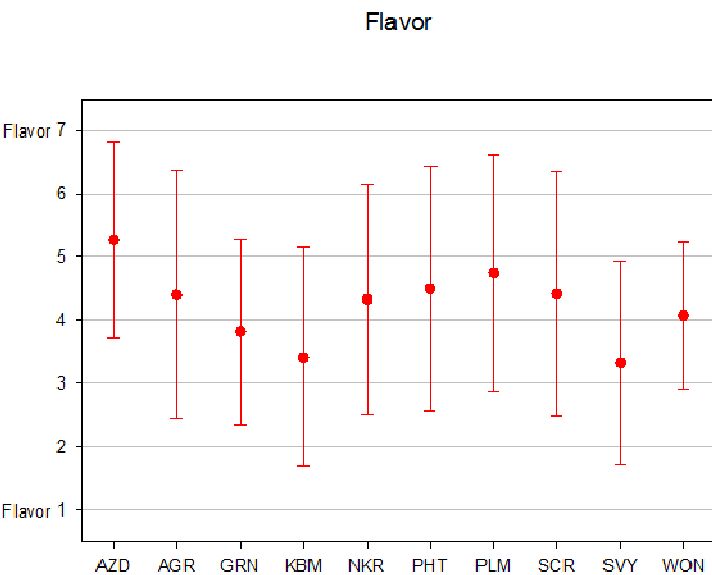
Sourness



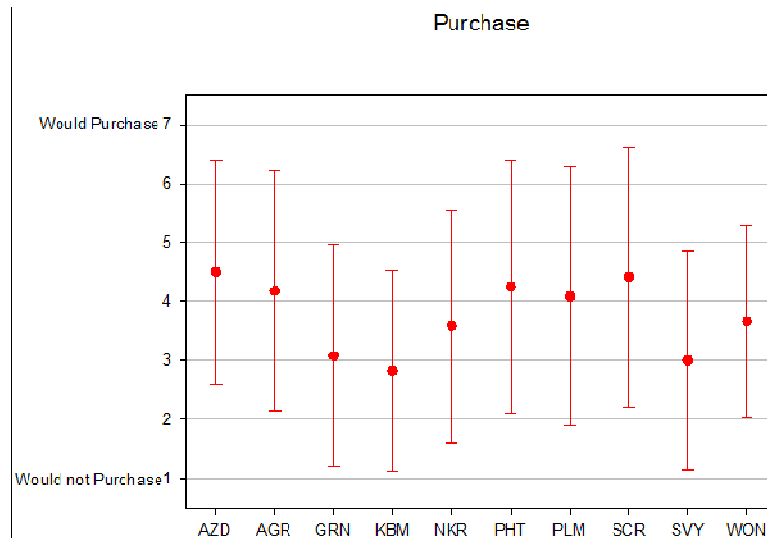
Results – Taste Test



Flavor



Purchase?



Bowie Issues



✂ In Bowie, the planting was freeze-damaged in 2012, and about 10% of the plants were lost. Plants are the smallest of the three sites, but are now mostly well-established and pruned to multiple trunks. Yields should increase. Adequate irrigation was a challenge, leading to fruit split. Control of leaf-footed bug (*Leptoglossus* spp.) is needed. Exterior and interior fruit color is darkest here, yet harvesting fruit at maximum brix:acid ratio is challenging. Bowie is a good opportunity for more commercial planting. We will continue evaluating the best cultivars at this site.

Tucson Issues



✂ In Tucson, plants are well-established, pruned to multiple trunks, and are the largest and yield the most of all the sites. Wind, bird, rodent and insect damage has been a challenge. Sunburn is problematic, and plants might benefit from shading. Regular irrigation has reduced splitting. Splitting and sunburn have greatly reduced yields of some cultivars, but not of others. Exterior and interior fruit color is usually acceptable, though harvesting at the maximum brix:acid ratio is challenging. The area is likely a good area for commercial planting. We plan to continue to evaluate the best cultivars at the site.

Yuma Issues



✿ In Yuma, plants are well-established and pruned to multiple trunks, but could be pruned to single trunks due to lack of freezes or significant wind damage. Tree size is good, but yields are not concomitant with size, possibly due to lack of chill. There is little rodent or insect damage, but birds are a problem. Sunburn is a challenge, thus plants are netted and treated with Surround™. Irregular (flood) irrigation leads to some split, though split is reduced due to the use of Surround. Due to the heat, exterior and interior color appear late, thus fruit must be maintained on the plant until at least November. The best performing cultivars will continue to be evaluated. New cultivars more tropical in origin (India), will be introduced and evaluated in Yuma. All new plantings will be established on trellises to shade the fruit and reduce potential for sunburn

