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THE DEVELOPMENT OF NEW CITRUS ROOTSTOCKS

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Abstract. **During the 1980's Florida suffered billion dollar losses due to cold, citrus Tristeza virus (CTV), Blight and Phytophthora. The purpose of this research and discovery which began in 1977 will deal primarily with development of new and better rootstocks which can survive these major citrus problems.**

The principal means by which these new citrus cultivars were selected was the old fashioned manner of "natural Selection" or survival of the fittest. Only one survivor out of 10 million would become the strongest parent for a new and better citrus cultivar.

The most devastating freeze in Florida's history occurred on Christmas Day in 1983. Over 90% of the Northern Citrus belt was destroyed. This catastrophe became for my research a natural test separating the genetic weak from the strong. This could only benefit the citrus industry if research and progressive lessons were learned and survivors were perpetuated from the great opportunity it presented, otherwise it would remain only a historical citrus catastrophe.

The main consideration of this paper will be directed toward cold damage, Citrus Tristeza virus (CTV), Blight and Foot Rot because they cause more mortalities than all others combined in Florida.

Cold Tolerance

During the winter months in Florida, citrus trees do not normally flush and they appear to be relatively inactive. At this time citrus trees are described as dormant and they are undergoing various physiological changes resulting in a condition called cold hardiness or tolerance.

A plant's cold tolerance is influenced by the scion and the rootstock. There are inherent differences in cold tolerance among scion cultivars regardless of the rootstock. Mandarins as a group are the most tolerant followed by sweet oranges and grapefruit. When sharing a common scion, it is also clear that rootstocks have a measurable effect on the cold tolerance of citrus trees. These differences are genetic. They are consistent and predictable. It is these genetic differences sought after most by this research.

Citrus Tristeza Virus (CTV)

Citrus Tristeza Virus (CTV) has been accepted by the industry as the most destructive disease of citrus. A multimillion dollar problem.

Blight

Citrus blight, a root-graft transmissible disorder of unknown cause has rendered millions of trees unproductive in Florida and elsewhere in the world.

Foot Rot and Root Rot

Foot Rot is a disease of the bark on the lower trunk or crown roots of citrus caused by the invasion near or at ground level of the soil-borne fungal organism, *Phytophthora parasitica*. The distinctly different damage caused by attacks on fibrous roots by the same fungus, is called root rot. It is a major citrus problem for most rootstocks.

Materials and Methods

We, at Little Green Acres, have grown millions of seedlings or replications from tissue culture and cuttings in developing the two finest ornamental and flowering trees ever developed in the State of Florida, the "Shady Lady" and the "Flaming Bottlebrush" of South Florida.

The company owned a tissue culture lab with a good microbiologist and three assistants on ten acres in Dade County. The nursery and landscape company had always owned and used a Beechcraft Bonanza airplane in the business. In addition it owned a fifteen acre parcel of land in Howey-In-The-Hills for field testing citrus along with a residence and small lab in Leesburg.

The A-36 Bonanza became the most useful tool. After the 1983 killer freeze it was used daily to survey and collect survivors from the entire northern citrus belt. The ground patterns were color coded and very interesting to survey and evaluate cold damage to 10,000 trees per minute. In 1983 the experiences of the billion dollar freeze brought focus on some very old "relic groves" of Sweet Orange Seedlings.

The trees within these groves were 90% infected with foot rot, but were tolerant to Exocortis, CTV and Blight. All were large trees with heavy yields and good quality fruit.

These were very unique 100-year old surviving seedling trees in an old relic grove. There were about 1% of these trees (probably replants) on different rootstocks. For the first time this situation offered the opportunity of comparatively testing the fruit of these different rootstock trees. By far the sweetest fruit and highest pound solids came from Sweet Orange rootstocks. Navel oranges, grapefruit and sweet orange were as high as 19% sweeter.

The big question of course is it a genetic characteristic? Stable, reliable and consistent. Can it be reproduced and field tested to produce the exact replication of the parent seedling mother tree?

In order to answer these questions, cuttings would be made and field tested for a few years for Tristeza, foot rot, Blight and quality of fruit.

All of the testing thus far has been positive and is now being validated and registered by the State of Florida budwood registration program.

Economic Significance

As Edison said, "There's a better way, find it".

We have developed five new and better citrus rootstocks cultivars that have the following unique characteristics:

1. Is immune or tolerant to the deadly disease citrus Tristeza virus and Blight which kills millions of citrus trees all over the world yearly.
2. Is very cold tolerant. Withstood the freezes of the 1980's in the northern citrus belt without damage.
3. Has a genetic characteristic for longevity. Will live and produce fruit for over 100 years, much longer than present rootstocks.
4. Is more compatible with scions than present day rootstocks, because it is more closely related, usually the same species as most scions (C. Sinensis).
5. All scions tested on these new sweet rootstocks produce a sweeter fruit than any other Sour Orange type rootstock.
6. One of the rootstocks is the first that may be used as a rootstock or as a scion. As a scion it is desirable as a high quality mid-season juice orange with high pounds solids(7.9) and sweeter than any other juice orange on the present market. It

grows extremely well on its own root from cuttings, produces fruit immediately, and will tolerate far more cold than budded trees. A $2,000 per acre savings for the grove owner solely on pound solids.

7. As a scion it may also be marketed for the fresh fruit market because of the large size and high quality sweet fruit (2 1/2" × 3"). One of the best candidates for nutritional supplements and cancer research because of its anti-virus qualities and high quality of juice and pectin.
8. It produces very high yields, up to 17-20 boxes at maturity. This could add enormous profits to the grove owner.
9. Is drought resistant because of its very deep root system.
10. Is tolerant to Citrus scab fungus (*Elsinoe fawcetti*) which is characterized on all citrus leaves except Sweet Oranges.
11. Will regenerate and send up sweet orange suckers and fruits immediately if a disastrous killer freeze or anything kills the scion union, unlike the millions of "sour type" unedible fruiting rootstock suckers in abandoned groves throughout the citrus belt today. This cost millions to the industry and is a complete avoidable major waste with new rootstocks.
12. Is genetically resistant to Foot Rot and Root Rot (*Phytophora parasitica*). Most sweet oranges heretofore have been reported to be the most susceptible. It has been tested. More field testing is desirable.
13. The first sweet orange rootstock to be successfully developed without major flaws. Ridge pineapple which has heretofore been tested by others is very susceptible to Phytophora and Tristeza.
14. Will tolerate a wide variety of different type soil conditions including high calcareous soils of South Florida.

Conclusion

These new citrus rootstock/scion cultivars were developed from Zygotic seedlings selected from thousands because they had all of the desirable morphological and genetic characteristics within single cultivars. Successive generations of sexual and asexual reproductions have been tested during the past decade by budding, tissue culture, and growing from seed. They have never been described or commercially distributed before.

The citrus industry can ill afford another major catastrophe like the 1983 billion dollar freeze. When it comes and ultimately it will because the history patterns of Florida freezes clearly predict it—just a matter of time. When it comes the catastrophic results will be appreciably the same because there's been very little done to rectify the problem, the genes are the same as before. If the new genetic cultivars and methodology are used as previously described, then Charles Darwin and Gregory Mendle's genetic laws of the universe would prevail. These scientific laws clearly predict with absolute certainty that the 100-year old survivors would perform precisely the same way *another* 100 years; if we simply replicate the parent tree by cuttings or tissue culture.

Cutting grown trees have been grown and tested in Lake County since the 1983 freeze with better results than any other method. Bill Baker has been the leading pioneer with over 100 acres to prove it.

The new citrus cultivars and methodology, a combination of cuttings and budding could save the citrus industry the same as the previous losses of **ONE BILLION DOLLARS**.

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DOES MOVING UNDERTREE SPRINKLERS INTO THE CANOPY ADD PROTECTION FROM COLD DAMAGE?[1]

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Abstract. **Little difference in the level of protection offered by various microsprinkler placements was observed following the Feb. 5, 1996 freeze in a 5 acre grove on the Main Campus of the University of Florida, Gainesville, during which the temperature in the grove dropped to 20.5F within the irrigated grove and to 15F at the Agronomy Farm 8 miles WNW of the grove. Damage to the trees was ranked from 1 (extensively damaged) through 9 (least damaged) on Mar. 14, 1996. The 455 trees were protected by 11 methods of sprinkler placement but with the rate to each tree held constant. The methods varied in both sprinkler number and in their locations on the ground beneath the tree and locations within the canopy. The means and SD for these treatments were 6.48 ± 1.55, 6.45 ± 1.69, 6.39 ± 1.55, 6.37 ± 1.69, 6.29 ± 1.62, 6.29 ± 1.79, 6.10 ± 1.91, 6.07 ± 1.62, 5.76 ± 1.41, 5.71 ± 1.66. No significant difference in the protection provided between any of the treatments was shown. No significant differences were observed between the undertree and intree treatments; 166 trees with sprinklers under them**

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