



**Deployment of Disease Resistant or Tolerant Citrus
Rootstocks and Scions**

**Project Organization Update
October, 27th 2016**



Introduction: Goals for CRDF related to HLB

- Support accelerated development and deployment of HLB-tolerant/resistant rootstocks and scions
- CRDF has committed funding to research for solutions
- Investment in research also comes from gov't programs, industry organizations, private companies and individuals
- There is need to understand the output from this investment



Outcomes from NAS Strategic planning HLB

- Support development of transgenic HLB-resistant and ACP-resistant citrus
- Develop a funding program with a guidance board
- Assemble team to develop and evaluate transgenic HLB-resistant citrus
- Develop strategies to support freedom to operate



Outcomes from Knowledge Mapping II

- Collaboration among CRDF, researchers, growers and industry partners
- Pipeline for potential HLB-Resistant candidates
- Plan combined side by side field trials with grower involvement
- Regulatory and IP considerations and approvals
- Timely delivery of varieties to growers



Program manager goals

- Past: Citrus research and production pre-HLB
- Recent Past: Strategic planning for the Florida Citrus Industry addressing HLB and Knowledge mapping II outcomes
- Present:
 - Short and long term HLB solutions
 - Project proposals and progress reports



Program Manager activities

- Meetings with UF and USDA/ARS breeders
- Reading proposals and progress reports
- Meeting faculty to learn about research activities
- Breeders and statisticians in other systems
- Visits to CRDF, USDA-ARS, UF, and grower field trials
- Transformation facility visits
- Extension outreach events, Citrus Expo
- Commercial nursery production
- Meeting growers and production managers



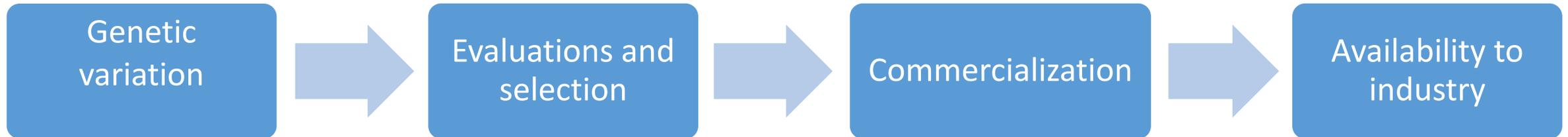
Citrus conventional and genetic engineering

- Difficulties generating genetic diversity, long juvenile periods and strict standards for traits of interest
- Biotechnology can present a quicker path to disease resistance
- Conventional and genetic engineering should work in concert
- Many organizations and individuals involved



Conventional Breeding (UF, USDA/ARS)

- Meetings with Researchers to understand programs



- Program pipelines
- Important traits and evaluation criteria
- On-going and planned field trial goals
- Potential candidates for advanced CRDF field trials
- Evaluation of candidates in CRDF trials to speed up release of potential varieties



Conventional Breeding (Outcomes)

- Discussions reveal biological challenges of citrus
- Different philosophies of breeding, research, and program pipelines
- Complexity - multiple programs with overlapping goals, working independently
- Selection criteria discussed reveal prioritization differences
- Selection criteria evaluated differently among individuals



Conventional Breeding (Outcomes)

- Many existing field trials with mixed goals
- Definition of later stage field trials varies
- Resources and planning for data collection – unclear
 - Grower trials
 - MAC trials



New Field Trials

- Grower trial
 - Randomized, replicated, 2 sites
 - < 2 years old, Hamlin and Valencias on many rootstocks
 - Requires resources for data collection
- MAC funding covers planning and tree propagation
- Rootstocks (MAC)
 - 2 trials, planned over 2 years, different experimental rootstocks
 - 6 Locations
 - Requested CRDF support for data collection
- Scion Trial 1 (MAC)
 - Fresh fruit Scions
 - 12 Diverse rootstocks (TBD)
 - Small trial : 3 sites, 7 reps, 3 trees per plot
 - Growers (TBD)



New Field Trials

- Scion Trial 2 (MAC)
 - 30 Experimental SO and SO-Like
 - 10 Mandarin
 - 1 rootstock, 3 sites, 3 reps, 70 trees/ plot
 - Growers (TBD)
- Assumes grower cooperator operation cost
- Request CRDF assistance with planting logistics and data collection
- Define criteria for MAC trial candidates
- Define requested CRDF support
- Define grower involvement (CRDF Goal)



Conventional Breeding (Outcomes)

- Define criteria for MAC trial candidates
- Define requested CRDF support for trial management
- Define grower involvement (CRDF Goal)
- Recently planned or planted field trials with most promising rootstocks and scions appear to lack planning and resources for data collection
- Mixed thoughts from researchers about establishing CRDF advanced field trials at this time
- Unclear if at present we can/should proceed with CRDF large-scale field trials



Genetic Engineering (Various Researchers)

- Read project proposals and progress reports Determine resources available to researchers
- Current pipeline (?) in the Core (Juvenile) and Mature Citrus transformation facilities
- Discussion of evaluation of transgenic materials with some researchers
- Molecular and greenhouse characterization
- Preliminary and advanced field trials
- Pipeline for transgenics for development and deployment, including regulatory concerns, consumer education and IP



Genetic Engineering (Outcomes)

- Project proposals reveal some overlap of project goals
- Characterization protocols not well defined
- Regulatory guidelines from USDA-BRS, FDA and EPA should inform protocols
- Molecular and phenotypic characterization protocols should be standardized
- Data collection at the all stages of development critical to deregulation
- Stage of testing of current transgenic materials unclear

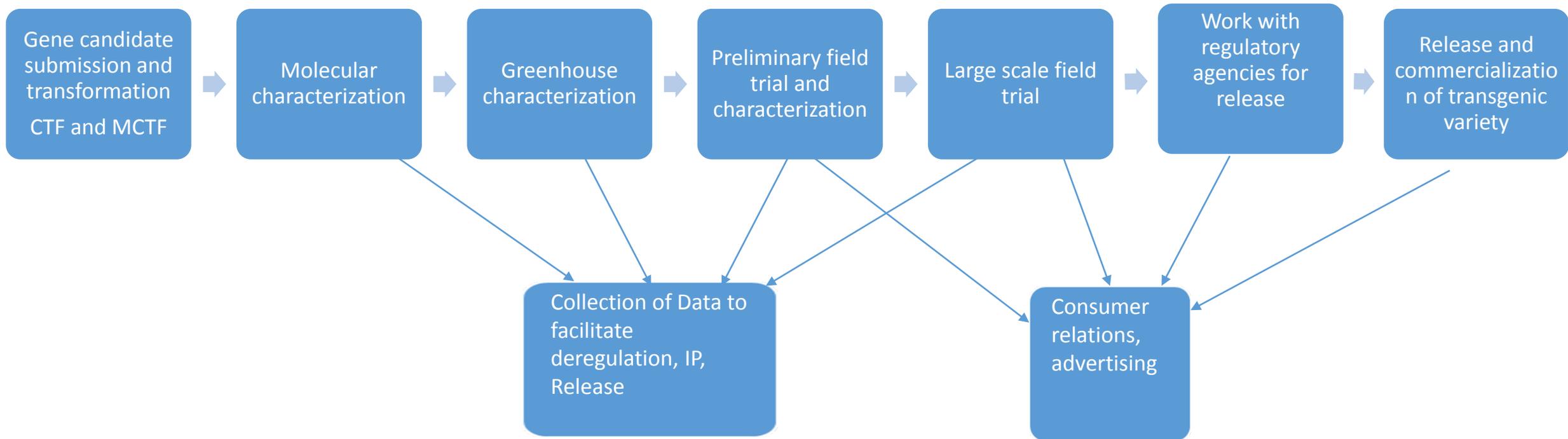


Genetic Engineering (Outcomes)

- Provide researchers with information about resources available
 - Contacts for permits and general regulatory procedures
 - Transformation laboratories
 - Permitted sites



Generalized Transgenic Pipeline





Summary

- Information on research findings will be curated and organized
- Quantify stage and number of field trials
- Develop standardized evaluation protocols for citrus
- Collaboration should be facilitated and encouraged across groups
- Decisions on allocation of resources to collect data on field trials are critical
- Stewardship of projects has the best chance of success in a complex environment

Citrus Research and Development Foundation, Inc.



Thank you!

CRDF is proud to provide support to the Florida citrus industry