

**FINAL PROJECT REPORT****(2015)****Project Title:** Consulting to the WTFRC for Apple Genetics, Genomics and Breeding

**PI:** Fredrick A. Bliss  
**Telephone:** (530) 756-5154  
**Email:** fbliss@dcn.org  
**Address:** 214 Inca Pl.  
**City:** Davis  
**State/Zip:** CA 95616

**Cooperators:** Jim McFerson, Cameron Peace, Kate Evans, Dorrie Main**Other funding sources:** None**Total Project Funding:** \$7,500**Budget History:**

<b>Item</b>	<b>Year 1:</b>	<b>Year 2:</b>	<b>Year 3:</b>
<b>Salaries</b>			
<b>Benefits</b>			
<b>Wages</b>			
<b>Benefits</b>			
<b>Equipment</b>			
<b>Supplies</b>			
<b>Travel</b>	4,000.		
<b>Plot Fees</b>			
<b>Miscellaneous</b>	3,500.		
<b>Total</b>	7,500.		

## **ORIGINAL OBJECTIVES**

1. Provide analysis and critique of technical aspects of proposals and reports for competitive funding of research and development related to apple improvement.
2. Provide a liaison between the RosBREED2 Advisory Panel and the WTFRC.
3. Participate in the annual Apple Research Review (ARR) and the affiliated GGB meeting prior to the ARR.
4. Facilitate integration of genetics and genomics with breeding and testing to accelerate optimum release and adoption of new apple cultivars and to make better use of existing cultivars for Washington State.

## **ACTIVITIES and ACCOMPLISHMENTS**

- Analysis and critique of proposals and reports to the WTFRC
  - Technical aspects of proposals and reports for competitive funding of research and development activities.
  - Program plans, documents and reports, proposals etc. for the Commission and Team members as needed throughout the year.
- Ideas and analysis of approaches and methods to facilitate adoption of new apple cultivars
  - Participated in the Apple GGB workshop prior to the Apple Research Review in Pasco, WA Jan 27, 2015.
  - Worked with Craig Hardner and other co-authors to complete manuscript of research paper, "Genetic architecture of apple fruit quality traits following storage and implications for genetic improvement", to appear in *Tree Genetics & Genomes*.
- Facilitated adoption and use of technology and materials from the RosBREED project and other R&D programs
  - Participated in the 1<sup>st</sup> year program review of the new RosBREED2 project in San Diego, CA Jan 8, 2015.
- Interacted with WSU and ARS scientists and PNW growers on scientific matters related to apple improvement
  - Participated in the annual Apple Research Review in Pasco, WA Jan. 28-29, 2015.
  - Attended Fruit and Nut crop workshop at the Plant and Animal Genome Conference in San Diego, CA Jan. 10, 2015.
  - Participated in WTFRC California nursery tour, March 1-4, 2015.
  - Provided insight and ideas to faculty and students about graduate education and training for fruit breeders.
  - Provided guidance to students and major professors about developing professional vitae, career roadmaps and job interviews.
- Submitted invoices for consulting on a quarterly basis and provided final annual report of activities.

## RESULTS & DISCUSSION

I reviewed and critiqued reports of continuing and finished projects and proposals submitted to the WTFRC for funding. I provided review and input of proposals being prepared by members of the GGB team. I reviewed the manuscript of the paper “*Decision support for cost-efficient and logistically feasible marker-assisted seedling selection in fruit breeding*” by Edge-Garza et. al. prior to submission for publication.

Much of the new genetic and genomic information becoming available to fruit breeders and researchers is a consequence of federally-funded competitive grants administered by USDA programs. Provision of matching funds by the WTFRC for large grants such as the RosBREED and RosBREED2 projects, as well as support for research proposals from WSU, ARS and other public scientists have enabled continuation of a world class apple improvement program. Dynamic programs in diverse disciplines in public and private sectors make possible maximize use of that information for solving problems and seizing opportunities to strengthen the Washington apple industry. The apple breeding program in particular has benefitted greatly from your continuing support to utilize molecular information for integration of molecular breeding into the ongoing program.

WSU scientists associated with apple improvement had important roles in the success of RosBREED, running the Genome Database for Rosaceae (GDR), and securing funding for RosBREED2. The position of the WABP would not have been nearly as advanced without these shared resources. Collaborative, community wide projects have been important for and will have a continuing impact on the ultimate success of the apple breeding program, measured by development and release of outstanding new cultivars. The WTFRC and WSU have been key supporters of these initiatives. This is a win-win situation wherein provision of matching funds leverages several times more federal funding for programs important to continuing profitability for the apple industry. There are numerous other apple breeding programs in the public and private sectors throughout the world that continue to produce new cultivars that compete with Washington apples.

RosBREED2: ‘Combining disease resistance with horticultural quality in new Rosaceous cultivars’ funded by the USDA-NIFA Specialty Crop Research Initiative is underway and making good progress. The \$10 million grant provides five years of support for research and innovation in rosaceous crop programs. I continue to participate as a member of the Scientific Advisory Committee which convenes annually for review. This is a critical resource for the WABP.

DNA-based information and technology are critical plant breeding capacity elements for successful cultivar development. The project ‘After RosBREED: Developing and deploying new apple DNA tests’ that is funded by the WTFRC is making good progress developing DNA tests for important quality traits and resistance/tolerance to biotic (e.g., powdery mildew, fire blight) and abiotic problems. Some of the physiological disorders (e.g., bitter pit, scald) that have been particularly difficult to ameliorate in the past now appear to be preventable. Molecular genotyping provides the opportunity for marker assisted selection of parents and preferred new genotypes along with genetic verification of selected phenotypes, and genetic fingerprinting of elite selections for intellectual property protection.

New methods, tools and materials are being incorporated into the WABP to enhance standard breeding practices and promising elite selections in the pipeline are being evaluated for commercial potential. The WABP is using new genomics and genetics resources to enhance

selection efficiency and effective evaluation for release of new materials to benefit the Washington apple industry.

Emphasis is now being placed not only on developing new tools that facilitate selection precision and efficacy but also on evaluating strategies for efficient deployment of resources. The recent paper published in *Molecular Breeding* “*Decision support for cost-efficient and logistically feasible marker-assisted seedling selection in fruit breeding*” by Edge-Garza et. al. (2015) provides diagnostic tools to make better use of resources and increase prediction accuracy of seedling selection during marker-assisted seedling selection (MASS). Information gained from different segments of the industry about valuable traits can provide additional insight into selection strategies that breeders and researchers should employ for effective apple improvement.

Advancement of promising new selections into pre-commercial testing, evaluation and commercialization is progressing very well, so an effective and efficient procedure for evaluating elite selections for commercialization is critical. New elite selections are being identified each year in the breeding cycle. The research paper, "Genetic architecture of apple fruit quality traits following storage and implications for genetic improvement" by Hardner et al. that will appear in *Tree Genetics and Genomes* provides insight into improved prediction of performance of elite selections as well as evaluating efficiency of apple breeding. A strategy to utilize phenotypic and molecular marker information along with grower evaluations and feedback from various stage trials to decide whether to either discard/discontinue selections or introduce and release them as new commercial cultivars is critical.

An important component of the strong research programs at WSU is educating and preparing the next generation of breeders and genetic support scientists. Grad students and post doctoral researchers have key roles in the research and outreach programs. I continue to work with faculty to discuss curriculum, courses and program components of plant breeder education and training.

## **EXECUTIVE SUMMARY**

I have consulted to the WTFRC for apple improvement for the past eleven years. During this time there has been an orderly transition from the founding breeder to leadership by a new breeder. The continuity of the program has been maintained and commercially promising elite selections evaluated and released for production. There is vigor, enthusiasm and momentum that reflects the commitment of the breeding and genetics team and their acceptance and use of new genomics and genetics tools and information that is changing plant breeding in general. The breeding, genetics and genomics programs have made excellent progress and have reached a level of maturity and productivity such that there have been minimal requests for my input and expertise. I believe I have worked myself out of a job which has been my goal as a consultant. Therefore, I am not submitting a funding request for the coming year.

Information, tools and materials provided through the initial RosBREED program and that continues from RosBREED2 will play a crucial role in the success not only of the breeding program but also other types of apple research. However those resources will have significant impact only if there are well supported programs in the public and private sectors in Washington State and the PNW. Progress in apple improvement has accrued in large part through outstanding support and collaboration among the PNW industries, WSU and the ARS-USDA. This is a strong and productive private-public partnership for which you should be proud and continue to support with clear direction and commitment.

New methods, tools and materials are being incorporated into the WABP to enhance standard breeding practices and promising elite selections in the pipeline are being evaluated for commercial potential. Emphasis is now being placed not only on developing new tools that facilitate selection precision and efficacy but also on evaluating strategies for efficient deployment of resources. Advancement of promising new selections into pre-commercial testing, evaluation and commercialization is progressing very well, so an effective and efficient procedure for evaluating elite selections for commercialization is critical. Information gained from different segments of the industry about valuable traits can provide additional insight into selection strategies that breeders and researchers should employ for effective apple improvement.

I have enjoyed this opportunity to work with you and surely have gotten as much or more than I have given. I will remain engaged with fruit breeding through participation in RosBREED2 and other interactions in the public and private sectors. I expect to see a continuing stream of exciting new apple cultivars moving into commercial use Washington and fruit of unprecedented quality in the market place.