



Veg R&D Forum

Davis, CA, USA April 10th, 2014

Notes June 2014

Speaker Presentations and Program available at:
<http://www.seedcentral.org/pastspeakers.htm>

SESSION I: BREEDING FOR SEED QUALITY; ADVANCES IN SEED TECHNOLOGY

Note-takers: Sara Dohle, Xiadong Sun, Monica Alandete-Saez

Industry Chairs: Gerard Denny and Teresa Mitzel

KEY DISCUSSION POINTS

- The presentations by **Alan Taylor**, Cornell University, and **Kent Bradford**, UC Davis, provided an overview of how seed technology and genetics can work together to breed for better seed quality and performance. As crop traits and protection are increasingly delivered via seeds, improving seed quality is essential. This can be done by understanding the genetics of seedling vigor, environmental effects on seed production during growth and increasing our understanding of seed coat permeability for seed treatments to enhance seed quality when the genetics and environment are limiting. The lectures offered a comprehensive overview of new seed technologies and highlighted the importance of targeted funding to support continued research in seed coating technology, growth enhancement, controlled release of chemicals, systemic seed treatments, and environmental compatibility.
- Though there are a number of priority research areas and needs in the industry, the **discussions stressed the limited research funding available for seed-related research.**

The group discussed that there are few sources of funding for seed quality and technology research. The American Seed Research Foundation (ASRF) is an important program, but it can only support a limited number of research projects. Roger Beachy urged Seed Central members to become familiar with two additional organizations/programs of particular interest to the agricultural sectors:

- Supporters of Agricultural Research (SOAR; supportagresearch.org) is an advocacy group that includes all agricultural professional societies and whose goal is to raise the awareness of research and its importance and inform the appropriate federal agencies. Precompetitive research areas identified by Seed Central members could be communicated to SOAR to assist in identifying matching funds from NIFA and other federal agencies.
 - Foundation for Food and Research (FFAR) is a mandate included in the farm bill to provide funds to match research support from private companies, potentially leveraging \$200 M for research.
- The limited research funding reinforces the need to **prioritize research areas** that can have the largest benefit to the seed industry. See below for a list of priority research areas that were discussed by the group.
 - **Public-private-partnerships** are increasingly becoming more important given that there are scarce resources to fund seed-related research. **Roger Beachy**, Director of the World Food Center at UC Davis, stressed the importance of public-private partnerships and of motivating the seed industry to develop a unified voice of its needs and get involved in policy formation and decision-making.
 - The vegetable seed industry should develop a **unified voice** to articulate its needs and influence policy in such a way that it benefits the Seed Industry as a whole.
 - Identification of **pre-competitive research areas** that benefit the entire industry is important to maximize the resources available for research.

SESSION II: HOW CAN VEGETABLE SEED COMPANIES WORK TOGETHER WITH THE U.S. AND STATE GOVERNMENTS TO ADDRESS THE CRITICAL FUTURE NEEDS FOR PLANT BREEDERS, BREEDING ASSISTANTS, AGRICULTURAL TECHNICIANS, PATHOLOGISTS, SEED ANALYSTS, ETC.?

Note-takers: Shamoni Maheshwari and Estefania Vincenti

Industry Chairs: Steve Wiley and John Mizicko

KEY DISCUSSION POINTS

- Allen Van Deynze from the UC Davis Seed Biotechnology Center spoke on behalf of the National Association of Plant Breeders and discussed the public-sector research funding landscape. Important sources of funding include:
 - The USDA NIFA and USDA/ARS are the main sources of public funding for plant breeding. Although there has been a 10% increase in the last year, funding for all agricultural research is now only \$308 M in 2014 (\$363 M requested for 2015). Considering the beneficial impact that plant breeding has had on society, this level of funding is minuscule compared to that of NIH and NSF that fund basic and medical research.
 - The Specialty Crops Research Initiative is a great opportunity for vegetable crops with \$52 M focused mainly on extension work and \$76 M in research. This research and extension grant program is part of the Farm Bill and requires matching funds from non-federal partners.
- The focused topic areas and relatively short duration of funding from grants make it challenging to maintain long-term public breeding programs.
- Public funding is essential for *basic research and long-term research* in plant breeding in all crops.
- Public funding and infrastructure are essential to *train* field-based plant breeders and agricultural researchers.
- Although private industry invests heavily in major commodities and vegetable crops, not all regions or crops are addressed for variety development and germplasm release.
- Competitive grants, long-term operational funding, updated infrastructure and equipment and emergency funds (for emerging threats to agriculture) are needed at the federal level.
- Funding should be across commodities.
- The industry stakeholders agreed that one of the main priorities for the sustainability of the industry and renewal of talent and leadership was **addressing the insufficiency of talented professionals and breeders necessary to fill the industry's collective human resources needs**. Participants discussed the lack of sufficient specialized professionals in areas such as breeding, plant pathology, seed testing, etc.
- The group also discussed the need for improving the **engagement of industry in Youth Education**. Participants shared their thoughts on the importance of promoting agriculture in general among the younger generations, even as early as kindergarten and elementary school. One of the key messages was the individual responsibility that each of us have to share career opportunities in agriculture.
- Similar to the discussion in Session I, the second theme in this session **focused on improving the advocacy to the federal government and unifying the voice of the industry**. While ASTA is a good advocate for the industry as a whole, the participants discussed that often the issues are focused more on field crops rather than vegetable crops. The participants discussed the possibility of developing unified messages specific for the needs of vegetable crops.

SESSION III. MANAGING AND CHARACTERIZING COMPLEX TRAITS, INCLUDING QUANTITATIVE TRAITS

Note-takers: Theresa Hill, Mohan Niroula

Industry Chairs: Jack de Wit and Jeff Zesche

KEY DISCUSSION POINTS

- Charlie Brummer, Director of the UC Davis Plant Breeding Center, discussed some of the roles of the center, including: consolidating curriculum and providing field experience; involving industry through student support and internships; developing educational programs for all ages; continuing to develop post-graduate education through Seed Central and the Plant Breeding Academy; increasing plant breeding faculty and staff at UC Davis and other academic institutions; and developing useful technologies and germplasm/cultivars to be licensed for commercialization.

Dr. Brummer remarked on modern developments in plant breeding and how genotypic data is no longer limiting for breeding efforts. Increasingly, making use of this data requires good phenotypic data. Lack of tools and capacity for high-throughput phenotyping is now the limiting factor. Dr. Brummer shared technologies necessary to support high-throughput phenotyping and described ongoing projects at UC Davis to develop such technologies. In addition, a proposal has been made to UC Davis to hire new faculty with expertise in this area.

- Discussions following the presentation once again centered on identifying pre-competitive goals for collaboration between industry and UC Davis. Areas of interest include:
 - Seed germination and vigor
 - Nitrogen use efficiency
 - Abiotic stress tolerance
 - Development of portable high-throughput phenotyping platforms; in general, industry is not well suited to tackle development of this type of technology internally.
 - Selection of model systems to develop data collection platforms.
 - Development of a bioinformatics platform for collecting analyzing data. Participants asked whether they can learn from other systems, e.g., Lemnatech/Danforth DOE bioenergy program.
 - Integration with other programs at UC Davis, e.g., agricultural engineering.
- Following the discussion from Session I, the group addressed what funding models could be used to support this research, and what funding and type of work could be accomplished in the public arena. The consensus was that consortia/matching funds models were most appropriate. This is an area that Seed Central can facilitate, as in establishing and coordinating research consortia among multiple private and public partners.
- Molecular markers will play an increasing role for all breeding programs; this may be an area for industry engagement.
- Will new breeding strategies need to be developed? Likely yes, since current methods were developed in the absence of the extensive genomic data that we now possess. Breeding methods would likely have been developed differently if we had this data. Areas for public-private partnerships include development of new breeding tools and strategies, evaluation of wild germplasm, identification and development of useful traits and education in statistics, experimental design and modeling.
- Other issues that were discussed included: breeding crops that can perform better with respect to global warming and abiotic and biotic stresses; plant-environment interactions; considering adaptability/plasticity itself as a complex trait; and the role of the industry in food security. These issues highlight the importance of speeding up the breeding process and increasing the rate of production of new varieties. This can be improved with the advance of technologies such as doubled haploid production and embryo rescue.

KEY ACTION ITEMS FROM SESSIONS I, II, AND III

- **Develop strategies to address funding deficiencies in seed quality and seed treatment research**, such as:
 - Develop strategies to increase funding opportunities.
 - Identify **potential funding sources and public-private mechanisms** to sponsor seed-related research that could benefit the vegetable industry, particularly once priority areas are identified.
 - Establish mechanisms for public-private partnerships, perhaps in precompetitive research areas (Seed Central CAPP, ASRF).

- **Identify pre-competitive research areas that could benefit the entire industry.** The group discussed that ASTA has led initiatives to prioritize research areas—this is something that needs to be followed up with them. In addition, the group identified the following research areas, listed below in no order of priority:
 - **Genetics of germination and vigor.** Are there homologous genes across species? Why are some seeds lots more vigorous than others? We need to better understand seed/seedling vigor, including how to quantifiably measure vigor, understand the genetics of vigor and how the environment during seed development affects seed quality.
 - **Evaluation of climate change and seed production.** What will be the effects of climate on seed production and quality? How does the environment affect seed quality? Are there genes that can be used as environmental sensors? Are epigenetics and methylation involved in maternal effects on seed quality? If so, can they be manipulated to improve seed quality?
 - **Develop high-throughput phenotyping methods appropriate for vegetable crops.** The ability to easily assess fruit load, disease severity, yield and other characteristics in a high-throughput and non-destructive manner is a high priority for advancing the pace of breeding and taking advantage of the availability of genomic/marker information.
 - **Find markers associated with an array of selectable traits.**
 - **Precompetitive research on control of seed-borne diseases.**
 - **Criteria for breeding for seed quality** and tools to aid breeding for key seed quality characteristics.
 - **Seed coat permeability needs to be better understood** to improve seed treatments where the environment and genetics are limiting.