**Plant Breeding Coordinating Committee**

**(PBCC)**

**SCC-80 ‘Imagining the Future of Plant Breeding’**

**Annual Report**

*Submitted 9/xx/21*

**PBCC Accomplishments and Impacts 2020/2021**

* The USDA-NIFA Higher Education Challenge Grant ‘Enhancing Educational Outcomes for Plant Genetic Resources Conservation and Use’ allowed the development of online courses and training materials on plant genetic resources. These courses and training materials are now available. The first graduate-level online course on plant genetic diversity (‘Plant Genetic Resources: Genomes, Genebanks, and Growers’) went on-line August 23, 2021. The Colorado State University course will be taught by plant geneticist Dr. Geoff Morris. It will be offered both in a ‘for academic credit’ version and a ‘non-credit’ version. <http://pgrcourse.colostate.edu/>.
* In addition, a public repository of plant genebank learning materials is now available at [GRIN-U.org](https://nam10.safelinks.protection.outlook.com/?url=https%3A%2F%2Flnks.gd%2Fl%2FeyJhbGciOiJIUzI1NiJ9.eyJidWxsZXRpbl9saW5rX2lkIjoxMDIsInVyaSI6ImJwMjpjbGljayIsImJ1bGxldGluX2lkIjoiMjAyMTA3MDcuNDI4ODY5MTEiLCJ1cmwiOiJodHRwczovL2dyaW4tdS5vcmcvP3V0bV9tZWRpdW09ZW1haWwmdXRtX3NvdXJjZT1nb3ZkZWxpdmVyeSJ9.lkuOfPK2znAZvDpgclN5c1kypocNitT9OOYWU_fDEsM%2Fs%2F862766547%2Fbr%2F108936577618-l&data=04%7C01%7Cricpratt%40nmsu.edu%7Cf8f6afe98e744eed42fa08d95774b1cf%7Ca3ec87a89fb84158ba8ff11bace1ebaa%7C1%7C0%7C637636981011550800%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=jTRrd27lMbJBWR45cqLZhaXimHX8eIwExlF%2FDX%2BbSqc%3D&reserved=0), part of USDA’s GRIN-Global site. Items are searchable by format (video, ebook, infographic, etc.) and topic. Training topics include: ‘Collection and Maintenance’, “Phenotyping and Genotyping’, ‘Crop Wild Relatives’, and “Plant Breeding’. Additions of content are expected in future. These instructional materials will be especially useful to the new generation of plant germplasm curators.
* PBCC sponsored a graduate student video contest to help promote the value and importance of germplasm resources to the future of sustainable crop production, and the value of graduate education in plant breeding (<https://www.nrsp10.org/PBCC_student_videos>). The winning video was submitted by Adam D’Angelo (University of Wisconsin). It is titled ‘[The Beet Family Reunion](https://youtu.be/XaifdN8b99o)’. The runner-up was a video about high quality soybean protein submitted by Renan Silva (University of Georgia). These videos highlight the importance of the USDA Plant Germplasm System by visually, and personally, demonstrating their use in cutting edge research to improve feed and food products used by everyone.
* A new graduate student video competition has been initiated. There will be two categories for contestants to submit video entries to: “Utilization and preservation of germplasm resources,” focused on germplasm utilization and conservation efforts and “A day-in-the-life of a plant breeding graduate student,” highlighting the fun and diverse nature of what graduate plant breeding training and education is like. https://www.plantbreeding.org/files/napb/video-contest-2021.pdf
* Initiated a survey on where our plant breeding graduates go to begin their careers. A preliminary report was presented on the current data received. PhD plant breeding graduates during the five-year period 2016-2020 numbered 360. Of those, 42% (150) went to private industry, and 49% (176) went to public positions (including post-docs), and 9% were unemployed at the time of graduation.
* The project proposal “Core Concepts: Roles in Graduate Plant Breeding Education, Curriculum Development and Monitoring” (PIs: Mahama, ISU; Luebberstedt, ISU; Retallick, ISU, Bohn, UIUC; Koundinya, UC-Davis) was submitted to the USDA-NIFA Higher Education Challenge (HEC) Grants Program.
* A team lead by Thomas Luebberstedt, and consisting of Anthony Mahama and Michael Retallick (all at Iowa State University), Martin Bohn and Dorrie Main continues preparation of a white paper on plant breeding core outcomes/concepts/learning objectives for university plant breeding courses. The partnership includes NIFA NRSP10 and NSF PGRP projects (PI: Dorrie Main), and University of Illinois Urbana-Champaign (Martin Bohn). Progress has been achieved and a journal target (Crop Science) has been selected.
* The U.S. public sector breeding capacity survey, in partnership with NIFA NRSP10 and NSF PGRP projects, was published in August 2020 (Coe, MT, Evans, KM, Gasic, K, Main, D. 2020. Plant Breeding Capacity in US Public Institutions. Crop Science 60:2373–2385. DOI: 10.1002/csc2.20227). Currently, 366 crop-specific breeding programs are registered on the NRSP10 map (<https://www.nrsp10.org/pbcc-survey-geomap>). The publication of this survey has increased awareness of national opportunities and needs and possible emergencies that may arise where plant breeding effort is below needed capacity. It has also provided valuable insight to policy makers, administrators, and the public into the infrastructure gaps that threaten public plant breeding capacity. This publication achieved unprecedented outreach impact (top 5% of all research Altmetric Attention Scores; comments received by nine news agencies and three blogs; [Forbes](https://www.forbes.com/sites/jordanstrickler/2020/08/11/lack-of-plant-breeding-programs-could-further-impact-food-security/?sh=62908a7b3c76) article accessed over 1,000 times, and one blog was read over 800 times).
* The publication Khoury, C.K., Kisel, Y., Kantar, M. et al. Science–graphic art partnerships to increase research impact. *Commun Biol*: 295 (2019). <https://doi.org/10.1038/s42003-019-0516-1> became the most tracked article of similar age in the journal Communications Biology. The article has been accessed over 28,000 times.
* The eBook Volk, GM, and Byrne, PF. 2020. Crop wild relatives and their use in plant breeding. Public domain (<https://colostate.pressbooks.pub/cropwildrelatives/>) has now been accessed by more than 2,000 users.
* A Seed World pod-cast [#NAPB 2020](https://seedworld.com/napb-2020-dave-bubeck-and-richard-pratt-on-public-private-cooperation/) was recorded by the Chairs of PBCC (Rich Pratt) and NAPB (Dave Bubeck) (published on-line 8/20/20)
* Additional best practices worksheets on plant breeding communication are available at <https://www.plantbreeding.org/files/napb/science-communication-for-plant-breeding-tips-combined.pdf>.
* A new PBCC web-site was created in cooperation with NRSP10

<https://www.nrsp10.org/index.php/PBCC_about_us>

* The above accomplishments have improved awareness among decision makers of the importance of genetic resources; improved communication among all plant breeders through partnerships with NAPB, American Seed Trade Association (ASTA), USDA, and the Seed Science Foundation to ensure the availability of crop germplasm; improved communication and awareness of genetic resources issues across public germplasm and breeding entities and private sector. New educational programs and products on germplasm collection and curation to meet training needs of plant breeders and germplasm curators were developed and released.

**2021 PBCC Annual Meeting (Virtual), August 16, 2021**

A general overview of accomplishments during the previous year was provided by the Chair, Rich Pratt. All four current objectives within the ongoing SCC80 project - 1) Resource Analyses 2 ) Genetic Resources Conservation and Utilization 3) Education and 4) Communication were addressed at the annual PBCC meeting. Additional information is provided in the ‘Minutes’ section.

The annual meeting was scheduled within the overall NAPB annual meeting program. It was also decided to hold the meeting remotely on Zoom to enable those participants who were not attending the NAPB meetings, to participate. There were 42 participants with the majority joining through the NAPB session, which did not successfully link to the Zoom meeting. The Zoom invitation was shared to overcome the dead link to the NAPB session. Approximately 38 state-reps and participants were in attendance along with Ann Marie Thro (NIFA REP-emeritus) and Robert Gilbert (ADMIN ADV.), Paul Zankowski (Senior Advisor for Plant Health & Production and Plant Products, Office of the Chief Scientist), and NIFA representative Ann Stapleton (see appendix list for contact information).

Sub-committee “breakout” meetings were held virtually the following week during the period 24th to 27th August.

Please see the appendix for minutes of the sub-committee ‘breakout’ meetings.

**FUTURE GOALS**

Below are goals for each objective for the new 5-year project:

**Objective 1: Resource Analyses**

*Collect, analyze, and disseminate information about the U.S. plant breeding effort in both public and private sectors, to include human capacity and access to enabling knowledge, technologies, germplasm, and infrastructure. [Chair, Wayne Smith]*

Regarding the survey concerning job-placement of Ph.D. plant breeding graduates, there was a consensus to continue to reach out to the remaining (non-responding) institutions through personal contacts.

Potential follow up:

* publication of data through letters to the editor of Crop Science and ASHS Journal, newsletters such as ACS News, distribution to decision makers through PBCC state reps, etc.
* contact a subset of respondents, e.g., the top 10 grantors of PhD plant breeding degrees, and determine percent going to post doc positions and the percent returning to their home country

Additional data of interest that we may wish to garner:

* number of universities offering an UG plant breeding degree
* number of universities offering an UG certificate or minor in plant breeding
* number of universities offering UG plant breeding courses but no degree or minor/certificate
* number of universities offering a significant module on plant breeding within a general UG course in agronomy/horticulture/plant or crop science.

**Objective 2: Genetic Resources Conservation and Utilization**

*Promote the conservation, characterization, and utilization of plant genetic resources and access to those resources for plant breeding. [Co-Chairs, Drs. Duke Pauli and Barb Liedl]*

Present objectives for this coming year

* New video contest to build on the two entries received last year
1. need additional content for promotional purposes
2. considered easy ways to engage public
3. the announcement is made and can be found at the end of the document
4. award amounts need to be updated
* Make regional data from germplasm committees available to all members.

**Objective 3: Education**
*Explore the U.S. plant breeding education capacity across universities and identify potential gaps and ways of achieving more uniform teaching capacity. [Chair, Martin Bohn]*

* Complete the “white paper” for submission to Crop Science
* Revise and resubmit higher education challenge grant.
* Discuss and develop action points for the following issues:
1. How is the capacity of teaching plant breeding distributed among institutions?
2. How are undergraduates exposed to plant breeding?
3. How do we deal with the lack of student diversity?

**Objective 4.** **Communication**
*Comments: Improve communication [1] among public plant breeders and federal-state-local agencies on plant breeding policy issues, including alerts to existing and emerging threats to agricultural security that are relevant to plant breeding; [2] among public plant breeding programs and university administrators through enhancing the mission and impact of PBCC state representatives; and [3] between the plant breeding community and public audiences. [ Chair, Dr. Mikey Kantar]*

* Perhaps turning the tip-sheet the “Best practices in communication” it into a manuscript? A possible target journal might be Natural Sciences Education? (https://acsess.onlinelibrary.wiley.com/journal/21688281 ) Iago and Rich expressed interest.
* Determine ways to improve “internal” communication. For example, the best way to advise the plant breeding community about recent products (of PBCC).
* Determine how to get PBCC to show up higher on the list of Google searches. One approach to improve visits might be to assign a visit to the website for a (plant breeding) class exercise.
* Post the instructions for registering for the new SCC80 project to the website.
* Develop packets of information the state reps could present PBCC products to the Deans and Directors at their respective institutions.
* Perhaps PBCC could develop a newsletter (quarterly) to help keep everyone informed regarding new hires, variety releases, PBCC products etc.
* Post a list all of the PBCC reps and participants at the new website. Perhaps add a picture and a link to their website, and post short videos they provide about their programs?

**Appendix**

**Minutes for PBCC Annual PBCC Meeting, Virtual, August 16, 2021**

Meeting convened at 12:00PM EST

1. Introduction
	1. Rich provided a welcome and overview of PBCC
	2. Explained the four main objectives of PBCC
2. Slide on Executive committee
	1. Explanation of executive committee positions and the roles they fill
	2. The four subcommittees and who chairs each one
	3. HBCU representation provided by Marceline Egnin and Barb Liedl
	4. Admin support from our NIFA representative Ann Stapleton and our administrative advisor Robert Gilbert
3. Plant Breeding Capacity/Resource Analysis
	1. Explanation of national survey now published in Crop Science (Coe et al, 2020), and the attention that it has brought us
		1. Lots of valuable data about the state of plant breeding
		2. Ability to look at data, and color graphics
		3. This publication has led to the newest objective led by Wayne
			1. New collection of data to learn where plant breeding graduates are going
			2. Gather information from department heads and state experiment station directors
			3. Resource analysis sub-committee meeting next week will discuss this topic
4. Genetic resource conservation and utilization
	1. Creation of videos about use of genetic resources in their graduate research program, inspired by idea at last year’s meeting and introductory videos produced by NAPB Borlaug Scholars
		1. Contest was well received
		2. Video submissions were fantastic, and everyone was encouraged to look at the videos (https://www.nrsp10.org/PBCC\_student\_videos)
	2. New contest to highlight the genetic resources as well as day-in-the-life of a graduate student
	3. Education component developed by Geoff Morris/Pat Byrne.
		1. New online course that students, new curators, etc. can take to learn about genetic resources, for credit or non-credit(<http://pgrcourse.colostate.edu/>.)
	4. There is other online educational material through GRIN. This is something supported by the USDA ([GRIN-U.org](https://nam10.safelinks.protection.outlook.com/?url=https%3A%2F%2Flnks.gd%2Fl%2FeyJhbGciOiJIUzI1NiJ9.eyJidWxsZXRpbl9saW5rX2lkIjoxMDIsInVyaSI6ImJwMjpjbGljayIsImJ1bGxldGluX2lkIjoiMjAyMTA3MDcuNDI4ODY5MTEiLCJ1cmwiOiJodHRwczovL2dyaW4tdS5vcmcvP3V0bV9tZWRpdW09ZW1haWwmdXRtX3NvdXJjZT1nb3ZkZWxpdmVyeSJ9.lkuOfPK2znAZvDpgclN5c1kypocNitT9OOYWU_fDEsM%2Fs%2F862766547%2Fbr%2F108936577618-l&data=04%7C01%7Cricpratt%40nmsu.edu%7Cf8f6afe98e744eed42fa08d95774b1cf%7Ca3ec87a89fb84158ba8ff11bace1ebaa%7C1%7C0%7C637636981011550800%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=jTRrd27lMbJBWR45cqLZhaXimHX8eIwExlF%2FDX%2BbSqc%3D&reserved=0))
5. Education
	1. PBCC committee members and collaborators submitted a proposal on defining the core concepts of plant breeder education
		1. Thomas Luebberstedt updated that the proposal was not funded but comments were supportive, and resubmission was encouraged
	2. PBCC members Martin Bohn and Thomas Luebberstedt and collaborators are also drafting a white paper on Core Concepts in Graduate Plant Breeding Training with an intended publication in Crop Science.
6. Communication
	1. Key publication, “Science-Graphic Art Partnerships to Increase Research Impact.”
		1. Well received, article metrics support this e.g. 28k article accesses
		2. Importance of transferring knowledge in a graphical form
	2. New website that is now live
		1. https://www.nrsp10.org/index.php/PBCC\_about\_us
7. Election of new PBCC Secretary
	1. Martin Bohn and Iago Hale are the two candidates
	2. Ballots close August 19th at noon (EST)
8. Budget report
	1. $600 spent on student video competition
9. New NIFA report
	1. New opportunities after December 15th for new information
	2. New Investigators
		1. New options in AFRI for beginning investigators
	3. Funding for Education
	4. AFRI opportunities from the Education and Workforce Development RFA
	5. Cultivar Development
	6. New program code for late-stage breeding
10. Reminder that participants need to update their information for the new SCC80 multistate project “Imagining the Future of Plant Breeding” in NIMSS system

Discussion

* Wayne mentioned that people need to try and coordinate with local administrators to get information on graduate student placement
* Attendees will reach out to respective contacts to get this information so that Wayne can continue combining and organizing
* Mikey will send out instructions on renewing membership with the SCC80
* Pat Byrne: inquired about video competition and where those will be posted. Rich explained that once the email distribution list is completed, the links will be sent out. The videos will also be posted on the PBCC website.
	+ Dave Bubeck can help with getting videos posted to the NAPB website while the position of web editor for NAPB is worked through.
* Mikey reminded individuals about the meetings for each subcommittee happening next week, asking people to attend at least one of the four meetings.
* Ann Marie Thro
	+ Had thoughts on the mission statement
	+ Part of the mission is helping the federal government understand what the funding needs are. This might need consideration for inclusion in the mission statement as this involves both state and federal level agencies.

Meeting adjourned at 12:55 EST

**Minutes for PBCC Annual PBCC Sub-Committee Meetings (Virtual), August 24-27, 2021**

**Objective 1: Resource Analysis**

**Convener: Chair, Wayne Smith**

Attendees: Wayne Smith, Richard Pratt, Francisco Gomez, Gerald Myers, Marceline Egnin, Duke Pauli

Activities report presented by Dr. Smith on the current data received documenting the number of PhD plant breeding graduates during 2016-2020.

* inquiries were emailed to 103 university departments in the U.S. soliciting information on the number of PhD plant breeding graduates in each year and if they had secured a position in private or public sector
* 46 responses to date
* over the five period, 360 PhDs in plant breeding were awarded with 42% (150) going to private industry, 49% (176) going to public positions (including post doc), and 9% unemployed at the time of graduation
* potential follow-up and additional data that might be sought were discussed (see Future Goals section)

**Objective 2: Genetic Resources**

**Conveners: Duke Pauli and Barb Liedl**

Attendees: Duke Pauli, Barb Liedl, Rich Pratt, Wayne Smith, Iago Hale, Jim McFerson, Peter Bretting, Ksenija Gasic, Kate Evans, Per McCord, Margaret Smith, Ali Missaoui and Felipe Barrios Masias

Welcome from Duke Pauli and Barbara Liedl. A summary of last year’s activities was provided. These included the graduate student video contests, the development of new educational opportunities in the area of plant genetic resources (the Colorado State University course taught by Geoff Morris). Past PBCC Chair, Pat Byrne, was a significant driver of this. Link: <http://pgrcourse.colostate.edu/>. A public repository of plant gene bank learning materials <https://grin-u.org/?utm_medium=email&utm_source=govdelivery> has also been developed and is now on-line.

Dr. Jim McFerson, participant on the National Genetic Resource Advisory Council, provided a national overview of the importance of genetic resource preservation. Dr. Peter Bretting, USDA provided an overview of the ARS response to Congressional request (in 2018 Farm Bill) to report on the status of the backlog regarding genetic resources and diagnose the issues. A ten-year plan, and a hefty budget, were proposed to address the issues.

Pat Byrne (who could not be present) also raised the issue of germplasm utilization (pre-breeding). There was further discussion and Peter welcomed further discussion with stakeholders outside USDA…such as PBCC. He also urged PBCC members to accept invitations to review one of the 150 (Acronym Needed) projects if invited to do so. The priority for next year will be to identify the top three priorities (for genetic resource preservation?).

Iago raised the topic of learning more about the non-governmental organizations involved in genetic resource conservation. There are mutual goals and more engagement might lead to more access to germplasm for the broader community and improved knowledge regarding best practices at NGOs etc.

PB - The NPGS is faced with determining “where we want to be” in 5- and 10-year time frames. Perhaps metrics could also be used by seed saver orgs.

He also added that there is now a big turnover of staff in NPGS and there are many new curators, for whom training opportunities would also be useful.

Discussion followed and it was proposed that we add a page to our website regarding outcomes – and add a list with links to NGO germplasm conservation groups. Rich added that we should probably add the governmental ones too, because many seed savers are unaware of them. Barb and Per agreed to help with this.

**Objective 3: Education**

**Convener: Dr. Martin Bohn**

Attendees: Martin Bohn, Rich Pratt, Wayne Smith, Iago Hale, Ksenija Gasic, Marceline Egnin, and Thomas Luebberstedt

Martin welcomed everyone to the meeting. Discussion elaborated on the highly variable configurations of departments and changes to the plant breeding curriculum at their respective institutions. It would be desirable for all departments to access to the necessary components of a core curriculum. Considerable discussion followed regarding the possibilities for internships for undergraduates (where many students are first exposed to plant breeding programs), how to administer digital courses, e-books, and the development of a white paper. One idea that was presented was the possible accreditation of plant breeding curricula (like that of an engineering curriculum).

ISU conducted a ‘Delphi’ survey to determine core competencies for the M.S. distance education degree in plant breeding. Perhaps PBCC- NAPB could send out a survey to determine the curriculum status quo?

Discussion followed regarding the diverse ‘gateways’ undergraduate students have to graduate programs in plant breeding and how opportunities for minority students could be improved.

**Objective 4: Communication**

**Convener: Dr. Mikey Kantar**

Attendees: Mikey Kantar, Rich Pratt, Kate Evans, Wayne Smith, Iago Hale, Jenny Koebernick, Han Tan, and Ksenija Gasic

Welcome from Mikey. He provided a summary of last year’s activities. These included development of a new PBCC website: <https://www.nrsp10.org/index.php/PBCC_about_us>. The new website provides increased functionality and better access to previously created materials (e.g. infographics ([https://www.nrsp10.org/PBCC\_plant\_breeding\_outputs](https://nam10.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.nrsp10.org%2FPBCC_plant_breeding_outputs&data=04%7C01%7Cricpratt%40nmsu.edu%7C92852f026ed5416cdd5c08d97356fcfb%7Ca3ec87a89fb84158ba8ff11bace1ebaa%7C1%7C0%7C637667639723839212%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=%2BofJVlqU%2FebUpEEd4Z5yt8emIamfX0TolK8ofHIcyT8%3D&reserved=0)) and manuscripts ([https://www.nrsp10.org/US\_public\_plant\_breeding\_capacity](https://nam10.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.nrsp10.org%2FUS_public_plant_breeding_capacity&data=04%7C01%7Cricpratt%40nmsu.edu%7C92852f026ed5416cdd5c08d97356fcfb%7Ca3ec87a89fb84158ba8ff11bace1ebaa%7C1%7C0%7C637667639723849211%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=udwIwCRX9%2BoYBkSygGnH1QnwIdeEFjwHK3xAac6vAaA%3D&reserved=0)).There is now increased access to previously generated materials on tips for communication in plant breeding ([https://www.nrsp10.org/PBCC\_reporting\_and\_admin](https://nam10.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.nrsp10.org%2FPBCC_reporting_and_admin&data=04%7C01%7Cricpratt%40nmsu.edu%7C92852f026ed5416cdd5c08d97356fcfb%7Ca3ec87a89fb84158ba8ff11bace1ebaa%7C1%7C0%7C637667639723849211%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=eXCUYgkmaPyC2DiJpZ44QTBPfZOcIyh81d9e62brbvw%3D&reserved=0)). For example, the “Best practices in communication” that is now up at the PBCC NRSP10 website.

We also implemented a video competition for graduate students to provide new material to highlight breeding success stories. New initiatives were started to develop a public speaking for plant breeding curriculum and to develop a new internal communication structure that leverages state representatives to disseminate important information to departments and administrators about plant breeding, this is especially important if they are not from the agricultural background. While resources are available, there is still a need for better dissemination of the information to many different audiences to ensure the sustainability of plant breeding across the country.

Mikey also provided a list of artists that one might wish to work with. They are Ellie Barber, Yael Kisel, Leah Kucera, Álvaro Valiño, Kelsey Nowakowski, and Nadia Niba.

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SCRAP

The public plant breeding program survey data published in Crop Science (see appendix). The article received a lot of attention from the popular press, in fact it received more media attention than any other Crop Science article in the last decade. The highlights of the study included; There have been significant reductions in personnel in plant breeding over last 5 years, program leaders are aging, there has been increasing budget shortfalls that have increased uncertainty endangering support of key personnel, decreased maintenance of core infrastructure & operations, and limiting the use of current technology. This has also decreased graduate and post-graduate training. There is a total of 366 programs that are searchable on the interactive U.S. map available at https://www.nrsp10.org/. The breeding programs are recorded by the crop since many breeders are working on more than one crop. The goal in the next 5-years is to repeat the survey to understand how things change over time. In the next cycle there is also a goal of trying to understand the capacity of the private sector, which will also explore the educational profile of the future workforce. A new method will be needed in order to maximize the amount of information that will be gathered that fills in gaps that are not already publically shared. There is potential to tie this into PBCC objective four to see what education private breeding companies are looking for in the future workforce. If you are interested in participating, contact KE, WS and or MBK.

The current focus is working on a common core for plant breeding that can be transferred across institutions. This has been done in the context of developed online degree programs and comparing the skills gained to what is expected in both the public and private sectors. This is also the case with respect to international constraints. This pedagogy work has been done in collaboration with education researchers as well. This leads to common standards and language regarding what students should know and what results in a professional career when they graduate from a program. This year work was done to develop core outcome/concept/learning objective lists generated for all Iowa State University (ISU) plant breeding courses, this was furthered by doing “course pairing” to identify gaps and redundancies to comply with Bloom’s taxonomy. The hierarchical web-tool for MS PLBR core concept/outcomes/learning objectives was made public after feedback from ISU and other institutions was received. Following similar idea as presented in Objective 2 for Plant Genetic Resources education. The next steps are to develop web-based system to enable regular discussions in the plant breeding community, and to identify what are core concepts for graduate level education. This tool could be further developed to incorporate tests, quizzes or similar, to determine which competencies are mastered by students. The goals for next year are to develop a white paper and to develop a higher education challenge grant to ensure the future of plant breeding capacity.