

INFORMING THE PLANT BREEDING CURRICULUM DEVELOPMENT PROCESS

A Delphi Study of Global Plant Breeding Education Stakeholders

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Abstract

There is currently a global demand for plant breeders greater than the educational system is producing. Companies have difficulty finding qualified breeders, while universities and research centers responsible for educating and mentoring the next generation of breeders are not being replenished. With the increasing demand, complexity and globalization of plant breeding, educational institutions around the world are working to strengthen their degree and extended education programs. The purpose of this study was to garner broadly based advice from stakeholders within the plant breeding discipline on a global scale. A web-based Delphi survey was conducted to determine what knowledge, experiences, skills, and specialties are important to prepare future plant breeders. Survey respondents were self assigned to 4 groups (public breeders, private breeders, recent graduates, and breeders from developing or emerging countries) as to draw out a broad range of ideas and differentiate curriculum needs. Responses that rated highly important for knowledge included disciplinary sciences, such as genetics and plant breeding, along with statistics and experimental design. Important experiences included practical applications in research and breeding, as well as an emphasis on the need for interpersonal experiences in the areas of scientific communication and collaboration. Skills that were most notable encompassed a range of research, analytical and statistical expertise and again competency in communication. Stakeholder responses to specialties included a broad sweep of topics with multiple groups focusing on molecular breeding coupled with standard breeding.

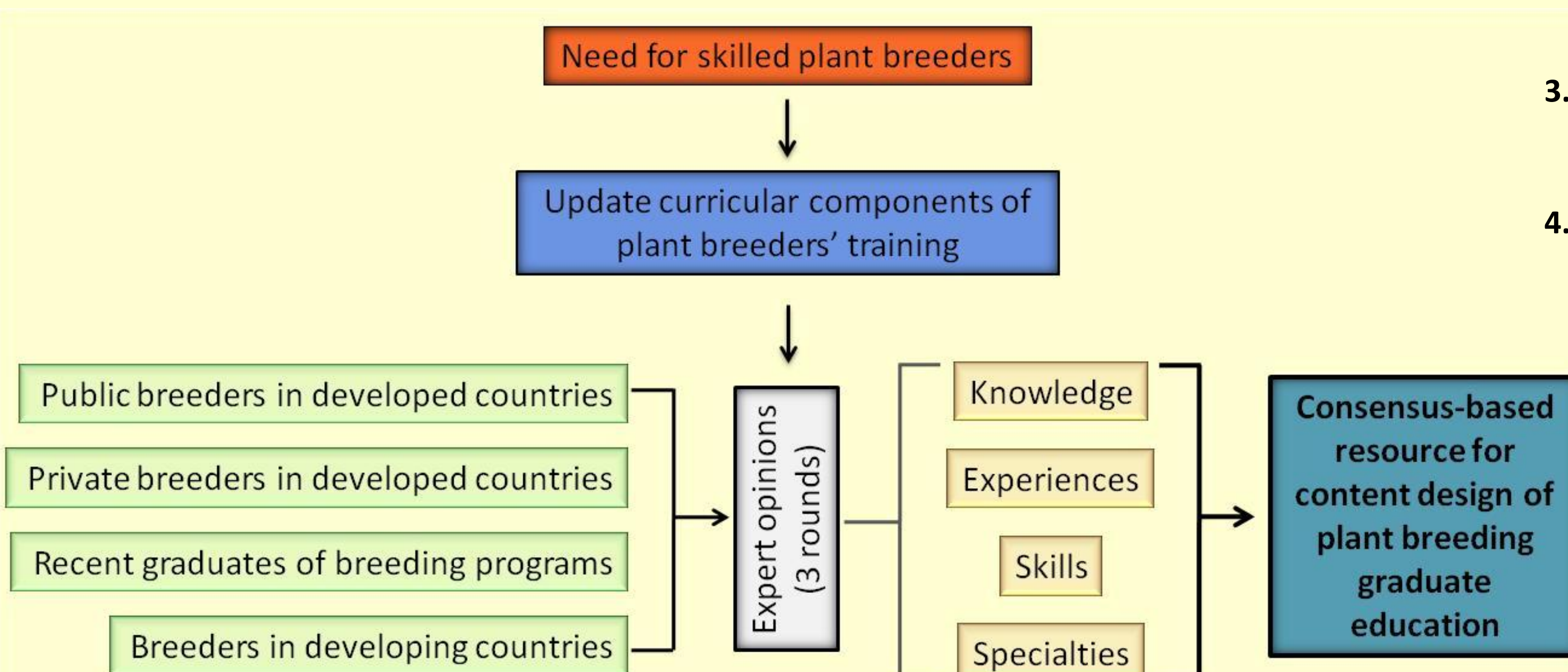
Methods

A Delphi study is a group process technique designed to direct informed judgment toward a consensus. It is typically conducted in three rounds and it has proven useful in defining curriculum content.

Study participants, identified by the Research Team with input from many outside sources, were selected to ensure representation from a breadth of disciplines, crops, countries and institutions. Almost 400 individuals were emailed personalized invitation letters asking for their participation in this web-based study, with 208 responding to the following open-ended questions:

1. What **knowledge** (topics or subject matter) is essential to have obtained at the completion of a graduate degree in plant breeding?
2. What **experiences** should a student have while pursuing a graduate level plant breeding degree that will contribute to his/her future success?
3. What **skills** and competencies should a student obtain by the completion of a plant breeding graduate program?
4. What **specialties** within plant breeding (or to complement plant breeding) should be developed over the next 10 years?

The researchers distilled and clustered responses into logical broad categories following Round I. In Round II, the same participants rated the importance of each item on a 1-5 Likert-type scale. In Round III, participants were provided both the group mean ratings and their previous personal ratings of all suggestions with a mean rating of at least 3.75. Stakeholders were asked if they still agreed with their decision, and if not to adjust their rating. Results from the final round were used in the analysis.



For more information related to this study, please visit <http://sbc.ucdavis.edu>



CONTRIBUTORS - This study was conducted by the UC Davis School of Education and Seed Biotechnology Center with the support of the following groups and individuals: American Seed Trade Association; Ball Horticultural Company; Fred Bliss; Michael Campbell; Global Partnership Initiative for Plant Breeding Capacity Building; The Monsanto Company; Monsanto Fund; National Council of Commercial Plant Breeders; Nunhems; Rijk Zwaan; Syngenta; UC Davis Department of Plant Sciences; Rick Watson; Gary Whiteaker. We would also like to extend special thanks to all participants for their time and thoughtful responses.

Results

- Over **3770 individual suggestions** were collected from **208 total participants** in Round I.
- The total suggestions were distilled down to **~1300 unique suggestions** that were rated by stakeholders in Round II of this study.

Table 1: Mean Scores for Experiences by Group

CATEGORY	PUBLIC		PRIVATE		RECENT GRADUATES		DEVELOPING	
	Mean	#	Mean	#	Mean	#	Mean	#
Scientific communication	4.29	12	4.04	9	4.38	6	4.04	9
Practical aspects	4.18	6	4.10	7	4.31	6	4.04	4
Plant breeding	4.47	6	4.35	6	4.45	5	4.32	5
Data management	4.41	5	4.42	3	4.64	3	4.44	5
Interaction and networking	4.10	3	4.11	1	4.36	3	3.98	3
Collaboration and teamwork	4.14	3	3.85	2	4.43	2	4.01	3
Teaching and mentorship	4.51	1	3.81	1	4.45	1	4.07	2
Experimental design			4.52	2	4.82	1	4.76	1
Program and personnel management			4.30	1	4.11	2		
Germplasm	4.05	1			3.95	1	4.12	1
Field visitation	3.72	1			4.09	1	4.18	1
Computer proficiency			4.07	1			4.15	1
Funding	3.87	1			4.09	1		

Mean: 3 = Neither important nor somewhat important, 4 = Important, 5 = Very Important; #: number of suggested sub-topics; Blank spaces indicate no mention of topic



Suggestion	Mean	SD
Ability to present and respond to questions	4.41	0.73
Reading and comprehension of research articles	4.37	0.78
Presentation of breeding program organization, structure and timeline	4.19	0.61
Writing a MS or PhD thesis	4.11	0.92
Technical writing (eg. reports, general article)	4.11	0.92
Creating and defending a project proposal	3.85	0.76
Presentation of research plan, progress report and results	3.81	0.94
Make a scientific presentation to lay audience	3.78	0.87
Participate in seminars	3.70	0.81

Conclusions

Responses to each of the four questions in this study offer the opportunity to evaluate similarities and differences between the stakeholder groups. Here we highlight a few of the most agreed upon conclusions suggested by the participants.

1. **Knowledge** – Stakeholders suggested that students graduating in plant breeding should have knowledge of disciplinary sciences, such as genetics and basic plant breeding, as well as social sciences, including scientific communication and ethics. They also emphasized statistics and experimental design. The need for content in areas related to the application of plant breeding, such as intellectual property law, was further noted.
2. **Experiences** – Stakeholders identified a range of practical experiences in research and breeding that can be provided both on and off university campuses. There was also significant emphasis on the need for interpersonal experiences in the areas of scientific communication and collaboration and teamwork.
3. **Skills** – Stakeholders identified a range of research, analytic and statistical skills necessary for graduates. They also advocated the need for scientific communication and program and personnel management to work effectively across multiple settings.
4. **Specialties** – While overwhelmingly focusing on specialties already well incorporated into many plant breeding programs (e.g., breeding for biotic and abiotic stress), suggestions also implied differential needs for specialties in crop quality, nutrition and novel trait development.

This study provides a means for administrators, faculty, recent graduates, private sector and developing country breeders to provide feedback on components important to educating and training the next generation of plant breeders for success. By bringing stakeholder input into program development and the curriculum design process, universities, research institutes and international centers can better prepare students for the future. Given the large number of participants and suggestions, future peer-reviewed publications are aimed at honoring the richness and depth of the information collected.

