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ISSUES

Crop Breeding & Genetics

Sustaining public plant breeding programs across generations

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Abstract

Plant breeding in the public sector is a multigenerational process that creates new plant varieties intended to meet current and future needs of society. Many public sector plant breeding programs are over a century old, and they continue to curate plant genetic resources that are far older still. While individual breeders serve as temporary leaders of these programs and the plant genetic resources they maintain, it is only their institutions that have the capacity to provide the necessary generational glue, enabling the accrual of long-term value to both breeders and society. Identifying best practices to ensure mutual benefit to both public sector breeders and their institutions is critical to achieving the smooth leadership transitions necessary for the sustainability and long-term impact of public breeding programs. The findings presented here suggest that the successful passing of the torch in such programs depends not only on strategic institutional support but also, critically, on the routine actions and mindset of the breeders entrusted with their leadership.

Plain Language Summary

Plant breeding has long been considered an essential public good. Despite many public breeding programs being over a century old, there are no standard procedures for dealing with inevitable leadership transitions. Here, we report on the findings of a workshop convened to explore the practices required for successful transitions and what current plant breeders and their host institutions can do to prevent germplasm loss and ensure program continuity.

Abbreviations: LGUs, land-grant universities; NAPB, National Association for Plant Breeding; PBCC, Plant Breeding Coordinating Committee; USDA, United States Department of Agriculture.

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1 | PUBLIC SECTOR PLANT BREEDING

Plant breeding, the creation of improved plant varieties for the benefit of people, has long been considered an essential public good due to its central role in maintaining food security. For the last 150 years, a staple of this social contract in the United States has been public sector plant breeding programs housed within the nation's system of land-grant universities (LGUs), many of which started breeding programs in the 1860s. Formalized as a modern scientific discipline in the early 20th century, plant breeding has been credited with between 25% and 50% of the increases in crop yields realized over this time (Bell et al., 1995; Duvick, 2005; Fischer et al., 2022).

Core Ideas

- Plant breeding is multigenerational, and program transition presents risk of loss of germplasm and knowledge.
- Leadership transition in public plant breeding programs must actively be planned to ensure long-term success.
- Successful transition requires consistent best practices within programs and coordination with host institutions.
- A culture shift regarding program ownership may be needed to maintain the health and impact of public breeding.

2 | RISK OF LOSS DURING BREEDING PROGRAM TRANSITIONS

The raw materials for the creation of new, improved plant varieties are current and historic plant genetic resources. In their ongoing work of stewarding and utilizing such biological resources to meet evolving societal needs, plant breeding programs often span multiple decades and individual careers, necessitating the transition of program resources and leadership due to retirement, position change, or tragedy. If a program transition is not executed successfully, longstanding public investment in the plant genetic resources developed and maintained by that program can be lost, along with its associated data and less tangible but invaluable program knowledge. Additionally, because breeders often serve as integral collaborators with other scientists (e.g., pathologists, food science specialists, agronomists, etc.) at their host institutions, other programs can also be greatly affected when breeding programs shutter. Such irretrievable losses constitute a breach of the social contract of breeding for the public good.

3 | THE CONVENING OF A WORKSHOP

Despite the inevitability of personnel transitions in public breeding programs and the clear risks of loss such periods of transition pose, no roadmap or set of best practices for successful transitions exists at any of the nation's LGUs. With funding from the United States Department of Agriculture (USDA)-National Institute of Food and Agriculture (Award 2024-67013-42196) and in conjunction with the 2024 annual meeting of the National Association for Plant Breeding (NAPB), the Hatch Multistate Research Coordinating Committee and Information Exchange Group SCC80 (Plant Breeding Coordinating Committee [PBCC]) hosted a 1-day workshop with the intent to identify and understand the various leverage points in facilitating successful transitions of public breeding programs. The 28 workshop participants convened to address this systemic issue included early career researchers, senior faculty, department heads, deans, agricultural experiment directors, and program directors from nonprofit organizations, universities, and the US federal government. The main findings from this workshop are presented below.

4 | ELEMENTS OF A STRONG AND STABLE TRANSITION

Two essential interrelated elements that define successful transitions emerged: (1) clear understanding and appreciation at the institutional level of the purpose and holistic value of the program, and (2) current, accurate, clear, and actionable documentation of the program's goals, protocols, and resources (including germplasm). Because neither of these elements can be developed quickly, planning for successful transitions should begin well before breeders leave their positions.

5 | VALUE ASSESSMENT—TO CONTINUE OR NOT?

However critical a breeder's role may have been in the visioning, establishment, and operation of a breeding program, the decision about whether or not to continue that program is entirely up to the institution. As outlined in several studies, one of the fundamental reasons for the need of institutional support is because granting agencies fund neither long-term positions nor entire breeding processes from start to finish, opting instead for discrete activities with shorter timeframes (Coe et al., 2020; Gepts & Hancock, 2006; Guner & Wehner, 2003). With finite resources and wide-ranging operations spanning education, research, and extension mis-

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TABLE 1 Key elements for multifaceted breeding program valuation, as related to institutional solvency and missions.

Cost recovery
Material disclosures, transfers, and licensing
Royalties
Grants
Research mission
Scholarly outputs
Disciplinary impacts
Research infrastructure provided by the program
Education mission
Students trained (classes, research)
Educational infrastructure provided by the program
Logistical experience working on plant improvement
Outreach and extension missions
Change in stakeholder behavior (e.g., variety adoption)
Change in stakeholder knowledge (e.g., field days, extension briefs, educational events)

sions, LGU administrators and State Agricultural Experiment Station directors must prioritize resource allocation on the basis of assessed value. The emergence of new scientific areas that need to be addressed in terms of research, training, and extension adds to the pressure that breeding programs, however longstanding, must overcome to ensure their continuity. No one is in a better position to articulate and advocate for the value of a program and mobilize stakeholders than the breeders themselves; it is therefore important that they give thought and attention to this well before transition looms.

Modern plant breeding programs typically have both research and breeding components, and it is imperative that breeders regularly and transparently disclose and communicate the multifaceted value of their programs. Beyond the financial considerations of varieties released, royalties generated, and grant dollars obtained, breeders should also cultivate and emphasize the educational opportunities and research infrastructure provided by their programs, along with the community connections, stakeholder involvement, and real-world impacts they enable. Table 1 lists some of the essential elements to be considered in a program's holistic value assessment.

6 | PASSING THE TORCH—KNOWLEDGE AND MATERIAL TRANSFER

If the decision is made to discontinue a breeding program, the fate of the genetic resources and data must be addressed if the loss of such public goods is to be avoided. This task of rational material transfer is made tractable by the same thorough and systematic value assessment referenced above. With a program's genetic resources clearly documented and disclosed, the institution is well-placed, ideally in collaboration with the outgoing breeder, to facilitate their transfer to external, interested public entities, whether other LGUs, federal agencies (e.g., the US National Plant Germplasm System), or public-facing nonprofits. Even with a willing partner, such transfers are complicated and incur costs. It is essential, therefore, to engage potential recipients as early as possible to identify key germplasm, determine its value and possible use, clarify ownership rights and limitations, project maintenance costs, and ensure the transfer of associated data.

If the decision is made to continue the breeding program, the complex task of operational transition must be addressed. Beyond a clear disclosure of the existence, value, and development status of the program's genetic resources, smooth operational transition relies on the establishment and accessibility of well-documented standard operating procedures and harmonized data storage. At the operational level, it is incumbent upon the outgoing breeder to organize and communicate the details of the complex system of program staff, collaborators, plant materials, equipment, facilities, and experimental locations vital to program success. Due to the number of people involved in a breeding program and the interdisciplinary nature of such endeavors, it is important to not only have practices documented (e.g., planting dates, seed storage, field protocols, etc.) but also their rationale explained (e.g., why certain locations are used). The current breeding program's goals and objectives should be clearly described so that they may continue or inform possible revisions. In addition, plant materials, either seeds or actively growing plants, must be maintained under conditions so that they remain viable during the transition process.

7 | STRATEGIZING PERSONNEL OVERLAP

In ideal circumstances, an incoming breeder's overlap with the previous breeding team of at least a single growing cycle/generation is recommended; thus, it is important for institutions to consider possible strategies for funding and facilitating such transition periods. Whether through formal employment or informal training sessions, overlaps offer invaluable opportunities for direct communication of complicated, nuanced, and/or hands-on information. Examples of opportunities include walking plots together, sharing on-site observations, and discussing the reasoning behind selection decisions. This period can also enable outgoing breeders to introduce their successors to key collaborators and stakeholders, thereby instilling trust in the new program leadership. Breeding programs may also employ highly skilled staff who can help ease the transition and enable knowledge transfer.

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Other invaluable sources of mentorship and support during times of transition can be found in regional partners and counterparts at peer institutions. These broader community stakeholders should be engaged to help maintain program integrity over generations.

Despite the clear advantages of personnel overlap, it can be an expensive proposition which must make sense in light of the program's value assessment. Even with sufficient funding, personnel overlap can be challenging in the absence of a well-defined timeline and clear ground rules. The network of faculty that surrounds and supports the breeder's work could become a key element in ensuring program continuity, by holding equipment and infrastructure and offering ongoing mentorship. Potential interpersonal conflict and antagonism can be greatly diminished through the establishment of clear and incentivizing institutional policies on intellectual property, as well as a clear demarcation of roles and decision-making processes during the overlap. Regardless of whether an overlap is possible, comprehensive documentation of breeding program operations, data, and materials remains essential (see Box 1), not only for operational continuity but for the clear articulation of program value to the institution.

8 | KEY INSIGHT: A NEEDED CULTURAL SHIFT AMONG PUBLIC PLANT BREEDERS

Throughout the workshop, it became clear that the subjective perceptions of plant breeders about the relationship between their programs and their institutions emerged as a potentially critical determinant of successful transition. The discussions at the workshop sparked two fundamental questions:

1. Do public plant breeders feel their programs are theirs or their institution's?
2. How do public plant breeders feel about the role of their institutions in their work?

In an effort to reach as many public sector plant breeders as possible, a brief anonymous survey was circulated among PBCC and NAPB members nationwide. Specifically, initial circulation was by email to the PBCC's roster of 58 state representatives and official members, as well as the NAPB's full roster of 627 members, only approximately 30% of whom lead public plant breeding programs. To reach PBCC and NAPB nonmembers, all recipients of the solicitation were requested to forward it to others in their professional networks. In the end, 176 individuals responded to the survey. Of those, only 111 indicated that they currently run public breeding programs, two for nonprofit foundations, four for the USDA, and the remaining 105 at universities.

When asked how they felt about program ownership, 46 (44%) of the university respondents indicated that they view the program they lead as theirs, while 59 (56%) view it as their institution's (Figure 1a). When asked further about perceptions of institutional support for their programs, the responses among university breeders were mixed, with no clear differences based on perceived ownership (Figure 1b). Notably, roughly one-third of the respondents indicated a perceived lack of active institutional support for the programs they lead. Although a survey of this nature has not been conducted in the past, thereby denying us a baseline, we speculate that generally decreasing institutional support for public plant breeding programs over recent decades may underlie these results. Encompassing breeder's salaries, shared technicians, field and greenhouse facilities, labs, equipment, promotion, access to allied disciplines, and more, the nature and degree of such support is diverse and variable across institutions.

To create and sustain multigenerational public breeding programs that can deliver on the promise of long-term public good, such programs must be firmly rooted within an organizational structure that transcends and bridges individual generations of leaders (i.e., within public institutions). Public breeders are well aware that their programs are owned by their institutions, in terms of the intellectual property they generate. And yet, the fact that nearly one-half of the survey's respondents feel their breeding programs to be theirs, rather than their institution's, indicates the existence of a potentially fundamental impediment to transparency and collaboration with institutional administrators and successors, therefore jeopardizing long-term program continuity.

9 | CONCLUSION

Successful plant breeding program transitions need to be strategically planned. The necessary groundwork for holistic value assessment, data organization, and material and knowledge transfer can take years; and current breeders are ultimately responsible for communicating the value of the programs they lead to their institutions. Most of the preparation needed for a successful transition relies on general best practices for the internal operations of the breeding programs, independent of whether a leadership transition is imminent. In this way, a well-run, well-documented breeding program that frequently and transparently discloses its value to its institution is ever poised for successful transition. In the end, though, successfully institutionalizing a program takes conscious effort on the part of both the institution and the breeder to ensure program continuity and maintenance of critical, unique germplasm.

Regardless of career stage, breeders entrusted with leading public programs should regularly ask themselves what would happen to the knowledge and genetic resources in their

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BOX 1 A minimum checklist of elements requiring clear documentation for successful leadership transition and breeding program continuity

Program goals and overarching objectives

- Product target(s)
- Product profile(s)
- Detailed breeding pipeline(s)

Major partners

- Up-to-date roster of program personnel, with job descriptions
- Roster of key collaborators, stakeholders, and beneficiaries, with contact information
- Roster of key administrative contacts, including those related to technology transfer
- Typical annual deliverables, with timelines and past examples

Financial information

- Up-to-date operational budgets, with funding sources and expenditures
- Projected resource needs (short-to-medium term)
- Examples of recent grants and/or contracts

Genetic resources

- Full inventory of unambiguously labeled genetic resources, including physical locations
- Up-to-date list of improved/disclosed materials, with development and IP status
- Key plant materials maintained to ensure viability during the transition process

Equipment, facilities, and fields

- List of facilities, with uses and contacts
- List of major equipment, with purpose and needed documentation
- List of field locations, with purposes and contacts

Standard operating procedures

- All routine agronomic/horticultural practices (for example, trial management, crossing, harvest, propagation, and seed/product storage)
- All routine phenotyping and genotyping protocols
- Data standards, including naming conventions, versioning, and access
- List of suppliers/vendors for routine materials, with contact information
- Technology transfer procedures and contact information

Data

- Phenotypic data, ideally digitized using a consistent ontology and loaded into a breeding database such as Breedbase (Morales et al., 2022) or the Breeding Information Management System (Jung et al., 2021) to maximize accessibility
- Genotypic and genomic data, ideally documented with clear metadata and stored in an accessible database

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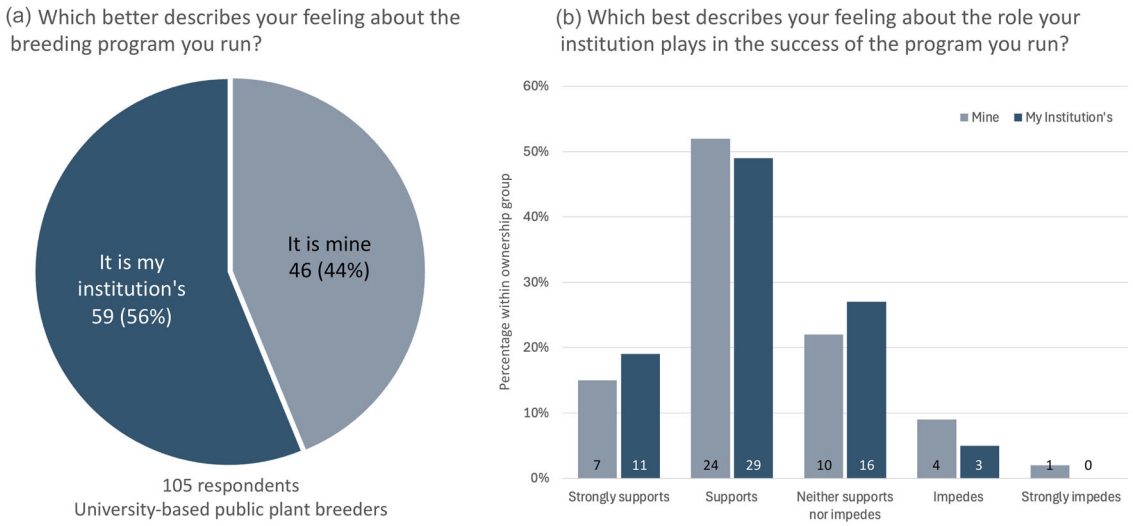

FIGURE 1 Of the 176 unique respondents to the survey, 111 currently run public breeding programs. Of those, two work for nonprofit foundations, four for the USDA, and the remaining 105 at universities. Here, we show a summary of responses of the 105 university-based public plant breeders to the survey's two questions, the first regarding their perceptions of program ownership (a) and the second regarding the perceived role their institutions play in program success (b).

stewardship if they were to disappear and then plan accordingly. As the intergenerational glue for such breeding programs, LGUs must also embrace various essential responsibilities, including simplifying the processes for routine value disclosure, establishing clear and incentivizing policies for royalty sharing (including those that bridge collaborative overlaps), and enabling strategic personnel overlap when needed. More concretely, consistent institutional support in the form of well-maintained germplasm storage facilities is clearly needed, particularly if the transition process is drawn out. To make best use of such institutional facilities, it is the responsibility of the breeder to establish storage best practices to retain viability and to routinely pare down collections to shed anything nonessential.

While the exact implementation of outgoing-to-incoming breeder knowledge transfer will differ from program to program, the absence of a formal planned transfer puts a program, and the genetic resources it maintains, at risk. Long-term value is maximized under a model of supportive institutional ownership, one in which breeding programs are viewed by all parties as endeavors held in trust by the current breeding team. Strengthening the sense of collaboration through open dialogue between breeders and university administrators will be essential to realizing a needed cultural shift regarding program ownership and maintaining the health and impact of public sector plant breeding.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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REFERENCES

Bell, M. A., Fischer, R. A., Byerlee, D., & Sayre, K. (1995). Genetic and agronomic contributions to yield gains: A case study for wheat. *Field Crops Research*, *44*, 55–65. https://doi.org/10.1016/0378-4290(95)00049-6

Coe, M. T., Evans, K. M., Gasic, K., & Main, D. (2020). Plant breeding capacity in US public institutions. *Crop Science*, *60*(5), 2373–2385. https://doi.org/10.1002/csc2.20227

Duvick, D. N. (2005). The contribution of breeding to yield advances in maize (*Zea mays* L.). *Advances in Agronomy*, *86*, 83–145.

Fischer, T., Ammar, K., Monasterio, I. O., Monjardino, M., Singh, R., & Verhulst, N. (2022). Sixty years of irrigated wheat yield increase in the Yaqui Valley of Mexico: Past drivers, prospects and sustainability. *Field Crops Research*, *283*, 108528. https://doi.org/10.1016/j.fcr.2022.108528

Gepts, P., & Hancock, J. (2006). The future of plant breeding. *Crop Science*, *46*(4), 1630–1634. https://doi.org/10.2135/cropsci2005-12-0497op

Guner, N., & Wehner, T. C. (2003). Survey of US land-grant universities for training of plant breeding students. *Crop Science*, *43*(6), 1938–1944. https://doi.org/10.2135/cropsci2003.1938

Jung, S., Lee, T., Gasic, K., Campbell, B. T., Yu, J., Humann, J., Ru, S., Edge-Garza, D., Hough, H., & Main, D. (2021). The breeding information management system (BIMS): An online resource for crop breeding. *Database*, *2021*, baab054. https://doi.org/10.1093/database/baab054

Morales, N., Ogbonna, A. C., Ellerbrock, B. J., Bauchet, G. J., Tantikanjana, T., & Tecle, I. Y., Powell, A. F., Lyon, D., Menda, N., Simoes, C. C., Saha, S., Hosmani, P., Flores, M., Panitz, N., Preble, R. S., Agbona, A., Rabbi, I., Kulakow, P., Peteti, P., … Mueller, L. A. (2022). Breedbase: A digital ecosystem for modern plant breeding. *G3*, *12*(7), jkac078. https://doi.org/10.1093/g3journal/jkac078

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