

The Reason Breeding Companies Established Genebanks

Subjects: Biodiversity Conservation

Contributor: Johannes M. M. Engels, Andreas W. Ebert, Theo van Hintum

Among the most important users of plant genetic resources, conserved predominantly in public genebanks around the world, are public and private plant breeders. Through their breeding efforts, they contribute significantly to global, regional, and local food and nutrition security. Plant breeders need genetic diversity to be able to develop competitive new varieties that are adapted to the changing environmental conditions and suit the needs of consumers. To ensure continued and timely access to the genetic resources that contain the required characteristics and traits, plant breeders established working collections with breeding materials and germplasm for the crops they were breeding. However, with the changing and increasingly more restrictive access conditions, triggered by new global legal instruments like the Convention on Biological Diversity/Nagoya Protocol and the International Treaty, plant breeders started to establish their own genebanks, to ensure continued and non-bureaucratic access.

Keywords: public genebanks ; conservation ; breeding companies ; cost ; efficiency ; genetic resources ; genetic diversity

1. Introduction

Genetic diversity, within and between species, provides the raw material for plant breeders to work with. This diversity has been readily available and without restrictions for a long time, until the 1980s, albeit increasingly threatened by genetic erosion. Plant breeders typically established and maintained working collections of selected materials of a given crop, including their own breeding lines, collected materials, and accessions obtained from public genebanks or (seed) markets elsewhere. With the introduction of a legal framework for access and benefit-sharing (ABS) of this genetic diversity, in fact, of biodiversity at large, access to genetic resources became more restricted or was even, in some cases, completely denied. During the last three decades, access to genetic diversity and benefit-sharing conditions has become more complicated and bureaucratic. Given the fact such access is an essential requirement for any breeder, breeders started to pay more interest in strengthening their own working collections. Eventually, seed companies established their own private genebanks to ensure their in-house breeders have permanent access to the genetic resources they need to develop new varieties.

In parallel to the above developments, many public genebanks, especially in developing countries, saw increased budgetary constraints, faced an increasing lack of required expertise and equipment, and thus became increasingly isolated from the global user community ^[1]. The mentioned increasing legal complexity of providing access to healthy and good-quality genetic resources further contributed to a weakening position of part of the public genebanks in offering targeted services to society and consequently resulting in less support for investments in conservation and use.

Considering the developments concerning access to plant genetic resources, an increasing number of breeding companies decided to expand their conservation efforts by consciously adding genetic diversity to the existing breeding collections of crops that are part of their breeding activities and, thus, establishing their own private genebank for long-term conservation. The first mention of breeding companies to have established their own genebanks for some crop species was made by Kate and Laird ^[2]. However, this development process of establishing genebanks by companies started much earlier but was possibly not published or reported ^[3]. Below the reasons why this happened are elaborated on.

The main reasons to establish a genebank by breeding companies have been grouped into two parts: (1). Cost and efficiency considerations; and (2). Securing future access to needed genetic diversity.

2. Cost and Efficiency Considerations

Breeding companies were already managing large working/breeding collections, sometimes of several hundred thousand samples, in the case of larger seed companies. Therefore, adding 'a few ten thousand' accessions acquired by purpose from different sources to increase the diversity would neither create a significant additional cost nor significantly increase the workload. Furthermore, having your own genebank with a good representation and documentation of the genepool(s) concerned contributes to considerable time and cost savings by not being forced to acquire or collect the required genetic diversity each time when needed.

When starting a screening process, it is advantageous to have the entire range of genetic diversity of a given crop already 'in-house'. Especially having sufficient seed quantity of the accessions to be screened saves considerable time and avoids the need to request new/additional germplasm materials, usually requiring extensive correspondence and time. When participating in research or breeding projects, or regional/global consortia, the sharing of germplasm is typically a precondition, and this requirement can be more easily met when having an own genebank.

Many national and institutional genebanks in less developed countries are operating on limited budgets and this frequently results in the distribution of poor-quality germplasm samples that often are not yet sufficiently characterized. Furthermore, the amount of seeds/plant propagules per sample provided by public genebanks is always limited, requiring a seed or tissue multiplication step before screening can be initiated, adding to cost and loss of time. Another, albeit less frequent comment related to the quality of the distributed germplasm is that the genetic composition of individual accessions might not meet the expectations of the recipients. For many of the evaluation activities, breeders need uniform germplasm samples. Especially when the requested material is used for molecular activities, the availability of accessions consisting of single seed descents would greatly facilitate their 'instant use'. However, many of the traditional genebank accessions are heterogeneous, and therefore require an additional step to obtain uniform samples for screening or evaluation activities. Related to this, public genebanks are frequently unable to respond, in a targeted manner, to trait-specific requests made by breeders for germplasm accessions and/or might not have the supporting characterization/evaluation data of the provided accessions at hand.

The phytosanitary status of germplasm accessions is an issue of increasing concern. Materials from public genebanks sometimes contain seed-transmitted infectious pathogens. This might be caused by the high costs or a lack of adequate and up-to-date seed health testing facilities and expertise in these genebanks ^[4]. Once the germplasm has been received by a private company genebank, the accessions/samples must be tested and cleaned, often a requirement of the national phytosanitary authorities, and thereafter maintained clean.

3. Securing Present and Future Access to Needed Genetic Diversity

Possibly the most critical reason for having an own company genebank is to ensure that good quality and securely conserved genetic resources are readily available to the in-house breeders to support pre-breeding, breeding, and research programmes, now and in the future ^[5]. Over the past years, it has become increasingly more challenging to acquire germplasm from national or local genebanks. The most important reason for this is that most genebanks have a policy to only provide a limited number of accessions per request and/or year and requester. Another reason is that several public national and many institutional genebanks that frequently manage crop-specific collections, lack a functional information management system and thus are not able to effectively deal with germplasm requests. A very different reason is that used material transfer agreements sometimes include a requirement that the obtained germplasm should be destroyed after a single use or a demand for high royalties upon the release of a commercial variety.

The current complexity of policy and legal instruments regulating access and benefit-sharing (ABS) arrangements for germplasm is possibly the most critical reason for breeding companies to establish and operate their own genebanks. In addition to current bureaucratic access restrictions, there is also a great level of uncertainty around the ongoing political debate concerning future ABS regulations triggered by the diversity in national legislation to address the requirements of the Nagoya Protocol ^[6]. This high degree of uncertainty about future germplasm access has motivated breeding companies to establish their own genebanks and to acquire a wide range of potentially useful genetic resources of company-specific target crops from public genebanks or through collecting missions. It should be noted that since the late 1980s discussions ensued about the application of property rights over newly bred varieties, typically protected through plant breeders' rights and increasingly with patents on plant traits and the underlying genes, but also varieties. As many developing countries and NGOs have opposed these developments, this issue has certainly contributed to critical views on the private sector and consequently, becoming more restrictive in providing easy access to genetic resources.

Some more specific points related to international, regional, and national ABS legislations and regulations, that have been raised in this respect include:

- Seed companies decided to maintain all accessions that had been obtained in the past from third parties in-house for long-term conservation to prevent having to do all 'the burdensome paperwork again and again'. Over the past years, it has become more difficult to import germplasm due to burdensome pre-shipping requirements, partly also due to the increased risk of transboundary spread of pathogens and insect pests ^[4];
- Typically, companies carefully study the conditions included in contracts such as material transfer agreements (MTAs), prior informed consent (PIC) and mutually agreed terms (MAT) from public genebanks and other sources that must be signed before accepting genetic material. If the conditions are unacceptable, especially when demanding unrealistic benefit-sharing requirements, such material will not be included in the company's breeding pool. In this context, the Nagoya Protocol should be mentioned as an important 'trigger' for these developments;
- An important legal aspect of the current benefit-sharing arrangements for a breeding company is that they oppose everlasting obligations. These are often included in MTAs and require that the company that does the introgression of an interesting trait from a genebank accession into breeding material has to pay as long as this trait is present in one of its varieties, whereas all competitors, who just take the trait from a released variety, based on the breeders' exemption, do not have to pay ABS. This rule thus puts the company that does the largest breeding effort in a disadvantageous position.

In summary, the reasons for breeding companies to establish their own genebank are manifold. In many instances, they are directly related to the fear of having to spend increasingly more time and money to obtain sufficient and good quality accessions along with the relevant information from genebanks around the world, or, in some cases, no longer being able to access those resources at all.

References

1. Engels, J.M.M.; Città della Pieve, PG, Italy. Personal Observation, 2023.
2. Kate, T.K.; Laird, S.A. The Commercial Use of Biodiversity. Access to Genetic Resources and Benefit Sharing, 1st ed.; Earthscan Publications Ltd.: London, UK, 1999; p. 418.
3. De Ponti, O.; Wageningen, The Netherlands. Personal Communication, 2023.
4. Kumar, P.L.; Cuervo, M.; Kreuze, J.F.; Muller, G.; Kulkarni, G.; Kumari, S.G.; Massart, S.; Mezzalama, M.; Alakonya, A.; Muchugi, A.; et al. Phytosanitary Interventions for Safe Global Germplasm Exchange and the Prevention of Transboundary Pest Spread: The Role of CGIAR Germplasm Health Units. *Plants* 2021, 10, 328.
5. Byrne, P.F.; Volk, G.M.; Gardner, C.; Gore, M.A.; Simon, P.W.; Smith, S. Sustaining the Future of Plant Breeding: The Critical Role of the USDA-ARS National Plant Germplasm System. *Crop. Sci.* 2018, 58, 451–468.
6. Ebert, A.W.; Engels, J.M.M.; Schafleitner, R.; van Hintum, T.; Mwila, G. Critical Review of the Increasing Complexity of Access and Benefit-Sharing Policies of Genetic Resources for Genebank Curators and Plant Breeders—A Public and Private Sector Perspective. *Plants* 2023, 12, 2992.
7. European Commission, Food Safety. Plant Health Rules. Available online: https://food.ec.europa.eu/plants/plant-health-and-biosecurity/legislation/plant-health-rules_en (accessed on 12 September 2023).

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