Chapter 12

The Seed Industry

Plant Breeding and the International Treaty on Plant Genetic Resources for Food and Agriculture

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Introduction

Plant breeding started about 9000 to 11,000 years ago when man started with the domestication of wild plants. Farmers and growers tried to improve their crops with desired traits through trial and error. The evolutionary theories of Darwin and the genetic experiments of Mendel that were developed at the end of the 19th century gave a further impulse to plant breeding and made it more efficient. During the 20th century breeding science was further improved through knowledge of genetics, plant pathology and entomology (Bruins, 2009).

The development of hybrids (starting around 1920) was the first technology in plant breeding to offer better plant varieties to growers and farmers. The new varieties were not only uniform but also often performed better than their parents due to the heterosis effect of hybrid vigour. The increasing use of seed treatment from the 1960s onward further improved yields, as the use of the plant protection products was more precise and therefore more effective. The latest step of innovations to further widen the opportunities plant breeding offers is the use of biotechnology. On the one hand biotechnology is used to better understand genetics and enables quicker interference in the breeding process with tools like markers. On the other hand, the precise introduction of genes through genetic modification, in particular for the major crops, has been a major breakthrough for plant breeding. Genetic modification led to an increase in yield, a reduction of the use of insecticides and an increase of income for farmers (Bruins, 2009).
Professional breeders

Commercial seed industry started around the 1740s with the earliest known seed company, Vilmorin in France. This company was quickly followed by more companies in France, The Netherlands, the United Kingdom and Japan. As indicated above, the plant breeding science became more and more sophisticated and an increasing number of specialized breeding companies were established. It needs to be noted, however, that in the last decennia, consolidation of seed companies took place starting in field crops, now being followed by vegetables and flowers. The global seed market increased from US$12 billion in 1975, to around US$20 billion in 1985 and was estimated at US$36.5 billion in 2007 (Bruins, 2009).

All in all plant breeding has become a highly developed science of how to combine desired traits of plants in one variety. Yield has increased, resistances to biotic stress and tolerance to abiotic stress have been incorporated and various qualitative characteristics like taste, earliness, size, nutritional value and so on were improved (Bruins, 2009).

Relationship between genetic resources and plant breeding

Plant breeding would not be possible if biodiversity did not exist. The recombination of required traits in a plant variety is the essence of plant breeding, whatever plant breeding methodology is used. Hence, for the recombination of the required traits, genetic variation is required. For the development of modern varieties plant breeders mainly make use of existing modern varieties that consist of sets of genes that are desirable for agriculture. Through recombination it is hoped to create even better varieties. When specific traits cannot be found in related varieties, other genetic resources like landraces, wild relatives and/or related species may be used. The latter happens at a level of 5–10 per cent at most.

Plant breeding is done by many players, by farmers, small- and medium-sized companies and multinationals. It also takes place in different regions of the world, even though the method of breeding and capabilities may differ. These activities do not take place independently, as plants from different users and different regions are constantly intermingled. This means that genetic resources are continuously moved around the world. This flow is essential for the future of plant breeding as it assures breeders that they can utilize the desired sets of genes.

Plant breeding is a continuous process of improvement, in which genetic resources are both an input and an output. The genetic resources that have been developed will be input for new breeding processes. Through plant breeding new variation, new diversity may be created (Van den Hurk, 2009). Lang and Bedo (2004) showed a great increase in genetic diversity of the Hungarian wheat varieties registered over the last 50 years. This is the result of breeders using a wide range of genetic resources to come to new wheat varieties. Moreover, farmers use a wider choice of varieties at present than in the past.
Van de Wouw et al (2010) demonstrated in two studies that reduction of biodiversity through the modernization of agriculture could be observed in the 1960s when diversity in the crops researched was low. However, diversity was rising again from then on until the end of the century. These trends over the last decades demonstrate that plant breeding has a positive influence on the biodiversity at the genetic level.

Recombination and use of genetic resources are not limited to one plant breeder and one region. Plant breeders made, make and will make use of genetic resources from each other, from different countries and backgrounds. Plant species have, for example, moved around the world and may have grown into important species in other parts of the world. It is believed, for instance, that Papua New Guinea and the surrounding region is the centre of origin for sugar cane. From there it moved to northern India, where a secondary centre of origin developed. Then it moved further around the world. Currently Brazil is the top producer (Willy Degreef, personal communication).

It is not only that plant species move around the world, but also that those species may be used for different objectives and therefore gain importance. Sugar cane, for example, is not only used as a sweetener, but has also become important for ethanol production. Furthermore, crops may adapt to different climatological conditions and move to new regions. Maize growing, for example, has shifted to northern Europe, while sugar beet has been adapted for tropical circumstances (Van den Hurk, 2009).

From the above it can be concluded that no plant breeder, no nation is completely independent in terms of genetic resources. Both developed and developing countries have come to rely on non-indigenous crops for their food, feed and fibre supplies. A study assessing the degree of a country’s dependence on non-indigenous crops (measured in terms of calorific contribution to nutrition contributed by crops whose centre of diversity is outside the country in question) has shown that all countries grow or import crops that come from distant lands (Palacios, 1998).

**The International Treaty on Plant Genetic Resources for Food and Agriculture**

From the above it can be concluded that genetic resources and plant breeding are closely intertwined. As the flow of genetic resources was at stake, it was important for the plant breeding sector to actively participate in the negotiations of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) (see Annex 1 of this volume for the list of all Commission and Treaty negotiating meetings). The focus of input has been on the multilateral system, access, benefit sharing and Farmers’ Rights (see Annex 3 of this book for details on the main provisions of the Treaty).
Plant breeding sector and the negotiations of the ITPGRFA

With the entry into force of the Convention on Biological Diversity (CBD) at the end of 1993, genetic resources were no longer freely available due to States' sovereign rights. At the time, the International Seed Federation (ISF) was of the opinion that the restrictions probably would have the most effect on public research, small breeding companies and developing countries poor in genetic and financial resources. Large companies and the developed world would be less affected as they have already collected materials from all over. Therefore, ISF supported the development of a multilateral system as proposed in the Global Plan of Action on Plant Genetic Resources for Food and Agriculture. This would leave as much freedom to operate as possible for the breeders (Coupe and Lewins, 2007).

The multilateral system should include all genetic resources of importance to present and future food security, and/or agriculture in general, at the level of genera and species: food crops, including vegetables and fruits, forage crops and mixed industrial/food crops. For each genus and species, the genetic resources should comprise wild relatives, landraces, obsolete varieties, and commercial varieties that are in the public domain (ASSINSEL, 1999) (for the list of genera and species, see CGRFA/IUND/4, Rev.1, pp40–43). Unfortunately, the final negotiated list of the multilateral system of the ITPGRFA was limited due to political reasons. Some main food crops like soy bean are missing. Furthermore, most important vegetable species are also missing from the list. Smaller crops like asparagus and strawberry are on the list while important vegetables like tomato, pepper, sweet pepper and onion are not on the list. This means that in the daily practice of plant breeders it is unclear how to deal with access to genetic resources that are not part of the list – leading to limited or no access at present.

In the negotiations of the ITPGRFA it was important to explain the interdependence of this treaty and the Union for the Protection of New Varieties of Plants (UPOV) Convention and the plant breeders’ rights defined in it, which is so important for innovation and further improvement of varieties in the breeding industry (ASSINSEL, 1999).

Breeders’ rights provide protection to a genome of the species, but on a specific individual plant variety in the development of which the breeder has invested. It is only limited in time. Moreover, thanks to breeders’ exemption, the variety to which the title has been granted is freely available for further breeding and the result of such further breeding is freely marketable, as long as the newly developed variety is distinct, uniform and stable and not a simple copy of the initial variety. In fact, the obligation to avoid plagiarism favours biodiversity (ASSINSEL, 1999). Hence the breeders’ exemption was a benefit on its own and ISF is positive that this was recognized in the final text of the Treaty.

The breeders’ exemption is not applicable in patents, which means that new improved patented material is not immediately available for further breeding. For this reason, ISF members indicated to be ready to study the possibility of balancing the resulting lack of immediate availability. When the results of a breeding/research programme which includes genetic resources provided by in situ
or ex situ gene banks, are patented, they agreed to participate in a fund to be established by governments, as decided in FAO resolution 3/91, and implicitly acknowledged in the Global Plan of Action. A material transfer agreement (MTA) that is linked to the multilateral system would be necessary to legalize access and benefit sharing. This ISF position, stated at the 5th extraordinary session of the Commission on Genetic Resources in June 1998, was necessary to finally get to a breakthrough in the negotiations of the benefit-sharing arrangements of the ITPGRFA (Cooper, 2002).

Whilst preferring a broad multilateral agreement, ISF acknowledged the need to keep open the possibility of bilateral agreements in exceptional cases (ASSINSEL, 1999). This could be, for instance, appropriate when a small number of countries have, or need, access to genetic diversity of a particular species or group of species, and/or when highly expensive and specialized research gives a strong competitive advantage to a single or limited number of institutions. Such conditions could prevail in the case of some industrial crops as, for example, rubber. In addition, bilateral agreements could be tailored to the needs of the parties; they could be created for specific purposes and then dissolved without the need of heavy structures; they could offer greater confidentiality (ASSINSEL, 1999).

**Plant breeding sector and the negotiations of the standard material transfer agreement**

To implement the multilateral system and make it effective, a standard material transfer agreement (SMTA) had to be developed. ISF supported the fast development of such an agreement and offered its experience with preparing contracts. From the start in 1998 of the negotiations on the agreement that later became the SMTA, ISF already defined several issues which should be considered in the agreement (ASSINSEL, 1999).

**Breeders’ exemption includes benefit sharing**

First of all, the material supplied should be available without any restrictions for the recipient for breeding and research purposes. According to ISF the recipient should neither claim legal ownership nor apply for intellectual property protection over the germplasm received, per se. However, it should be possible to protect plant varieties developed from the material, if the criteria of protectability are met, by plant breeders’ rights, or any other sui generis system consistent with the UPOV Convention, or by patent, according to national law. This also meant that cells, organelles, genes or molecular constructs isolated from the material may be protected by the recipient through patents, if the criteria for patentability are met (ASSINSEL, 1999). This approach of ISF was generally accepted and is incorporated in the SMTA (see Articles 6.2 and 6.10).

Another important criterion for ISF, which existed as early as 1999 in its official position and occurs for protection under UPOV-like systems, considers that the free access to the new varieties for further research should be recognized as a contribution to benefit-sharing (ASSINSEL, 1999). As stated before, ISF
could see that when the results of the research are patented, the recipient should pay to the multilateral agreement fund (the Resolution 3/91 or 3/91-like fund) a certain amount of royalties, to be accepted on a contractual basis (ASSINSEL, 1999).

In the negotiations on the SMTA the part dealing with benefit sharing has taken a fair amount of time and the seed sector has been active to participate and provide relevant information. The benefits of the breeders’ exemption have been recognized in the final text of the SMTA. According to Article 6.7 of the SMTA there is no obligation for any further benefit sharing; however, voluntary contributions are welcomed according to Article 6.8.

**Benefit-sharing requirements**

To agree to the benefit-sharing requirements, be they obligatory or voluntary, several bottlenecks needed to be dealt with. The first point to discuss is the contribution of the germplasm to the final product. This may be divided into two parts, the amount of work and research that needs to be done to get to a variety, and the contribution of the germplasm to the final product.

In the negotiations it became clear that a good balance between the work of the plant breeder and the contribution of the germplasm should be sought. A breeding process takes at least ten years and often longer, in particular, when wild relatives or landraces are used. Moreover, plant breeding companies spend 10–15 per cent of their turnover on research and development.

In the discussion on the contribution of a genetic resource the plant breeding sector suggested the following elements to be considered for benefit sharing. First of all, it would look to the amount of DNA that was incorporated in the final product. The plant breeding sector was of the opinion that benefit sharing should only take place when a great part of the genetic resources could be found back in the final product; a minimum of 25 per cent should be incorporated. In addition, benefit sharing should be able to be triggered when an identifiable trait of value or essential characteristic of the genetic resource was incorporated. Secondly, the amount of available knowledge on the genetic resource could be considered relevant. The more you know on the genetic resource, the less risk you need to take to work with the material.

The amount of DNA incorporated has been discussed in a great detail. It was not possible to come to an agreement though on what part of the DNA of the genetic resource should be incorporated. The main concerns were the traceability and control of such a system. Therefore, it had been agreed that any incorporation of a genetic resource should trigger benefit sharing be it voluntary or obligatory.

The amount of knowledge known beforehand has not been debated any further in the context of triggering benefit sharing. In fact, it was decided that information that was not confidential that became available from research of the germplasm should be shared. Knowledge sharing is considered an important form of benefit sharing.

Once it was decided what would be the trigger point for benefit sharing, the benefit sharing itself should be discussed. The seed sector pointed out that the percentage of
the profit to be agreed upon cannot be very high, as any incorporation is a trigger point. Furthermore, they found it important that the percentage would be taken of the net sales, meaning that (i) discounts, customary in trade, (ii) amounts repaid or credited by reason of rejection or returns, (iii) any freight or other transportation costs, insurance, duties, tariffs and sales and excise taxes based directly on sales or turnover or delivery of products and (iv) any licence fees, should be subtracted from the gross income. Especially the developing world was concerned about the net sales; they expressed their concern on transparency on what would be subtracted from the gross income and what would not be. On the other hand it was understood that payment should not be settled on income that the breeder did not receive. To overcome the problem, the plant breeding sector estimated that the income losses of the above mentioned points are around 30 per cent (Le Buanec and Noome, personal communication). In conclusion it had been decided that the obligatory benefit sharing would be 1.1 per cent of the gross income minus 30 per cent.

A third issue in the negotiation process that took time and thought was the determination of the exact moment when benefit sharing should take place. In this discussion ISF indicated that double payment should be avoided. Furthermore, ISF was of the opinion that a reasonable point in the development chain should be found for the benefit-sharing moment (Le Buanec and Noome, personal communication). In other words, it would be important that the user of genetic resources is not forced to follow his product to the final consumer. The point of commercialization of a product was finally defined as the moment that a recipient and/or its licensee sell a product on the open market.

A fourth issue to be dealt with was the multiple uses of genetic resources in breeding programmes. To simplify the benefit-sharing system and make it work it was agreed that only one payment should be made, even if more genetic resources under more SMTAs were involved.

The fact that benefits are only created after a long time was another potential problem. This would mean that benefits would be shared only in a later stage. To circumvent this situation another option for benefit sharing had been designed. Recipients of genetic resources could opt for a lower percentage of the sales, but then on all the sales of a certain product whether germplasm was incorporated or not and/or whether the product would be available for research and breeding or not. The seed sector was involved in the discussions of this option, and saw opportunities in this approach. However, the percentage 0.5 per cent that was finally agreed upon is considered too high.

**Other contractual issues**

A dispute settlement was agreed upon. For the seed sector it was important that a dispute could only be initiated by either the provider or the recipient. Later, it became also relevant that the third party beneficiary would also be able to initiate this. The seed sector could support this (Le Buanec, personal communication; ESA, 2005).

The seed sector was of the opinion that terms on duration and a termination clause should be included as in any contract (Le Buanec, personal communi-
cation; ESA, 2005). During the negotiations no agreement on those items was possible and a duration and termination clause was left out.

**Implementation of the ITPGRFA and the SMTA**

Once the SMTA was agreed upon, it was important to implement the multilateral system of the ITPGRFA. In some countries the implementation was taken care of immediately, while in most countries it seems more difficult to implement the multilateral system and the SMTA. The exchange of germplasm continues with the countries and regional and international institutes that have implemented the SMTA. In countries where the SMTA is not implemented, no or perhaps limited exchange is taking place. For vegetables no examples of bilateral agreements are known, except if they are based on the SMTA.

If no agreements are made, benefits are not shared. Therefore, the plant breeding sector stresses the need for an effective implementation of the ITPGRFA, putting the genetic resources into the multilateral system and making them available under the SMTA. Only then, materials may be used in a sustainable manner and can be conserved.

The conditions of the SMTA are sometimes also used for non-Annex I crops. This is strongly supported by the seed sector as this creates a level playing field between Annex I and non-Annex I crops. Moreover this may assist in the support for extension of the list of Annex I. That the conditions of the SMTA are useful as a benefit-sharing tool is demonstrated through some collection missions that have been carried out recently by the Dutch gene bank CGN, financially supported by the Dutch breeding companies. In negotiations with Uzbekistan and Tajikistan it was agreed that collection missions on wild spinach could be carried out under the following conditions: the mission would be paid for by The Netherlands and the materials would be shared between the countries and CGN. Moreover, the collected materials can be given out by CGN under the conditions of the SMTA. A similar mission for wild *Allium* species has been agreed upon with Greece.

With regard to the use of the SMTA some bottlenecks need to be further discussed among parties and with stakeholders. The number of SMTAs that are being signed is increasing and the administrative burden may cause unnecessary inconveniences for both user and provider.

Another issue for consideration is the passing on of SMTAs to future users and the information that needs to be provided to the third party beneficiary. As the extensive administration may be cumbersome this may limit further distribution of genetic resources.

Putting genetic resources into the multilateral system needs to be stimulated and facilitated. Issues of concern for the seed sector doing so are several; the burden of administration is one. Secondly, it is not clear if it is the accession that becomes part of the system or the genetic constitution/information. This may be relevant as seed lots may be split in several parts: one for the multilateral system, one for own use and another for further distribution under own conditions or so. Lastly, it may be important to make arrangements so that providers of genetic resources to
the multilateral system that for any reason lost their own part of the accession can obtain a copy of their accession though the multilateral system without signing an SMTA; they in the end have brought it in. Finally, the seed sector recognizes that using the SMTA to access genetic resources of Annex I that are maintained in situ is also important and should require more attention.

**Link to the access and benefit-sharing system of the CBD**

Currently an international regime on access and benefit sharing is being negotiated under the CBD. This regime is dealing with all genetic resources for all uses. The seed sector is of the opinion that the ITPGRFA should be recognized in those negotiations and should be excluded from this general regime. Moreover, it would be good to obtain recognition for the system as a workable system for access and benefit sharing that, in particular, suits industries, like the seed sector, that deals with a continuous flow of genetic resources. In other words it may be useful to extend the rules of the ITPGRFA to the whole breeding sector and possibly other sectors that deal with a continuous flow of genetic resources.

**Farmers’ Rights**

The negotiation of the ITPGRFA was not only focused on a multilateral system, but also on Farmers’ Rights. This was felt necessary to recognize the contribution of farmers to the conservation of genetic resources. ISF could support recognition for the farmers; and finds it also important to recognize the contribution of the plant breeding sector.

During the negotiations, ISF explained that plant breeders’ rights do not have any negative impact on the activities and work of farmers and, in particular, subsistence farmers. Furthermore, ISF stressed that UPOV and, in particular, the section on farm-saved seeds would not be undermined.

As far as farm-saved seeds are concerned, Article 15 of the UPOV Convention clearly states (i) that the breeders’ rights shall not extend to acts done privately and for non-commercial purposes and (ii) that each contracting party [to UPOV] may, within reasonable limits and subject to the safeguarding of the legitimate interests of the breeder, restrict the breeders’ rights in relation to any variety in order to permit farmers to use for propagating purposes, on their own holdings [a] protected variety.

The plant breeding sector was and is of the opinion that any rules on Farmers’ Rights should be implemented at a national level as all jurisdictions have different systems to involve stakeholders including farmers in policy development, and benefit-sharing arrangements. ISF, therefore, could support the text of Article 9 of the Treaty, as long as all elements are recognized and respected.
Concern about the implementation of Farmers’ Rights has been expressed by several parties. ISF supports the fact that Article 9 of the Treaty should be implemented and used to call upon the parties to assume their national responsibility.

In their latest position paper on Farmers’ Rights adopted in 2009, ISF provided information on the importance of plant breeders’ rights for both farmers and plant breeders and also explained the coherence between plant breeders’ rights and Farmers’ Rights (ISF, 2009).

To encourage the continuous and substantial investments required to support breeding and the large-scale characterization and conservation of germplasm undertaken by the commercial sector, ISF is of the opinion that breeders – whether companies or individuals – must have the opportunity to protect their new varieties through intellectual property rights in order to obtain fair remuneration. Therefore, ISF strongly supports plant breeders’ rights based on the UPOV 1991 Convention as it provides an adequate protection of plant varieties against inappropriate exploitation by others.

In relation to Farmers’ Rights, it is important to note that this protection is combined with free access and use for further breeding purposes (breeders’ exemption) and also the compulsory exception of acts done privately for non-commercial purposes allowing subsistence farmers in developing countries to save and use seed from their own harvests (ISF, 2009).

Most national laws recognize and protect intellectual property. They allow protection of new plant varieties created by breeders through years of breeding effort and significant economic investment to the exploration, characterization and development of germplasm as intellectual property. The Treaty does so too. Even as Article 9 calls for Farmers’ Rights it does not exclude the intellectual property of commercial plant breeders. Article 9.3 expressly acknowledges that implementation of a system that allows farmers to ‘save, use, exchange and sell farm-saved seed’ rests with national governments ‘subject to national law and as appropriate’. The Treaty recognizes that each contracting party has its own domestic needs and priorities, and recognizes that a contracting party may also have obligations under other international agreements and conventions it adheres to.

Farmers are the primary market for new varieties developed and protected by commercial plant breeders. Free and unlimited use of farm-saved seed that is harvested from protected varieties developed by plant breeders destroys the economic incentive for those breeders to continue to conserve, characterize and develop the available genetic resources in important food and feed crops. If farm-saved seed of protected varieties is permitted and used, breeders should receive fair remuneration for that use. Failure to respect and protect the property newly created by breeders will eventually restrict the release of genetically diverse and improved varieties to the detriment of farmers and to society as a whole. However, farmers still have the opportunity to freely use seeds of landraces and seeds of varieties that are not or no longer protected, independently of the consent of the breeder (ISF, 2009).
Conclusion

For the plant breeding sector it is important to have sufficient freedom to operate to carry out their breeding activities and have the necessary access to plant genetic resources. This means that a flow of genetic resources should continue to take place. It is important to realize that access is required both in developed and developing countries. In the latter it may become even more important as the plant breeding sector is expanding. Moreover, genetic resources should be available for all type of users, be they small, medium-sized or large enterprises.

The value of the breeders’ exemption should be continuously recognized. This guarantees a continuous flow of genetic resources of which plant breeders and thus farmers and economies will benefit.

As Annex I is only limited, it is important to consider the extension of Annex I. Many important food crops are still not on the list, while they are important for feeding the world and providing the necessary variation in diet. The seed sector would like to invite the member countries to implement the multilateral system, and make access and benefit sharing possible. As long as Annex I is not extended the seed sector urges parties to still make use of the conditions of the SMTA for the exchange of plant genetic resources that are used in plant breeding. This has proven the most successful in recent years.

So, it is important not only to implement the ITPGRFA as broadly as possible, but also to take care that the system as such is recognized and respected by the negotiators of the access and benefit sharing regime of the CBD.

With regard to Farmers’ Rights the plant breeding sector can support Article 9 of the Treaty as long as it is implemented nationally. The Treaty text states the same and therefore should not be changed and/or interpreted differently. It should be realized that the needs of stakeholders and socio-economic context differ from region to region and from country to country.

The fact that Farmers’ Rights and plant breeders’ rights can coexist needs to be recognized and respected in the implementation of Article 9. Contrary to what is argued by some sections of society, Article 9.3 does not provide any legitimacy to save, use and sell farm-saved seed. The ITPGRFA remains consistent in recognizing existing obligations arising out of national legislation on farm-saved seed. Therefore, the special dispositions authorizing the use of farm-saved seed that States have implemented – as part of their national legislations on plant breeder’s rights – can remain unchanged.

Notes

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References


