Seed Diversity in Organic Agriculture

Draft IFOAM background paper on plant breeding and seed production

Introduction

For most of human history, seeds have been regarded as sacred, and it is easy to understand why. Seeds provide the all-important link from last year's harvest to this year's crop, on which our life has depended since the neolithic revolution. It was the understanding of seeds and their management that made agriculture possible and created the economic basis for modern human societies. 1

Crop seeds incorporate the accumulated history of plant domestication, all the biological and cultural adaptation we have achieved during the past twelve thousand years. Even more importantly, they contain the blueprint of the future. The genetic makeup of seeds reflects the ideals and visions of the farming systems that create them, and every time a seed is used it contributes to making those ideals reality.

Plant breeding is fundamentally about choices. Regardless of the methods used, from field selection to complex laboratory techniques, breeders can achieve only a certain number of changes at a time. For example, they must choose either to select for plants that are efficient at utilizing soil nitrogen where it is scarce, or for plants which give maximum yield when nitrogen can be supplied in optimal amounts. They can give priority to taste or disease resistance, to early maturity or high protein levels, but not equal weight to all of these at the same time. Because of the slow pace and long-term nature of plant breeding, the choices made by plant breeders continue to shape agricultural production for many decades, sometimes centuries.

This is why organic agriculture will never be able to develop its full potential without seeds developed in keeping with the organic vision. As long as organic farmers need to work with seeds bred to realize a different vision of the future, they will be carrying a constant handicap. This is especially true as well adapted seeds are a much more crucial factor in organic farming, which is much more locality dependent and limits itself regarding external (chemical) inputs to compensate for biological shortcomings.

Yet, organic plant breeding and seed production have been slow to develop. The reason is mainly economic. Organic farming is still a small proportion of agriculture in most parts of the world, and this has made it difficult to create a separate seed supply for the organic sector.

With continued rapid expansion of organic production worldwide, the economic possibilities for organic plant breeding and seed production are now improving. At the same time, the need is becoming more urgent. Public sector breeding is disappearing in most countries, and the private seed business, now dominated by agrochemical corporations, is concentrating its resources on genetic engineering and other highly manipulative techniques. Central breeding goals of these corporations, such as herbicide tolerance, in-plant pesticide production and other adaptations to industrial farming systems, are entirely irrelevant to organic farmers. In addition, the widespread and careless use of genetic engineered varieties increasingly contaminates the seed supply all the way down to foundation seed sources. If current trends in conventional plant breeding continue unchanged, the seed choices available to organic producers from the mainstream seed business will be further reduced rather than improved.

[1] The word "seed" is used here, and throughout this document, as shorthand for propagating materials of all kinds, including tubers, cuttings, bulbs and other forms of vegetative propagules.

For consideration is whether the development of organic plant breeding and seed production should be a major priority for the coming decades. Given the high costs and long timeframes involved in seed development, creating a fully organic seed supply chain is a formidable task, which requires not only new technical expertise but also innovations in social and economic structures, as well as changes to legal and political frameworks. The aim of this position paper is to identify key issues which need to be addressed in order to begin this necessary transition, and propose some first steps to be taken

The History of Seeds and Breeding

Until very recently, plant breeding and seed production was always an integrated component of farming itself. Selecting and saving seed was something that each farmer did as part of the annual cycle of crop production. Over thousands of years, this created a vast genetic diversity, with seeds finely adapted not only to the growing conditions in each village, but also to widely varying food habits and cultural preferences.

Traditional on-farm seed systems produced no "varieties" in the modern sense of uniform and unchanging pure-line genotypes. On the contrary, seeds were maintained as relatively diverse populations which constantly evolved in response to local selection pressures – natural as well as human – and the occasional external input via seed exchanges with neighboring villages or more distant sources. This meant that agricultural crops remained exposed to evolution much in the same way as wild plants, only with a much larger influence for humans as a selection factor.

What changed everything was the rediscovery of Mendel's work in 1900 and the development of modern genetics, with the subsequent rapid expansion of scientifically based plant breeding. Until then, the commercial seed trade had been limited mostly to horticultural and other specialty crops, while farmers had stayed firmly in control of their field crop seeds. Mendelian plant breeding was able to deliver spectacular results in the 1920s and 1930s, with crop yields doubling and more, plus higher levels of resistance to common plant diseases. Within a few decades, most farmers in Europe and North America started buying the new varieties and stopped maintaining their own seeds, most of which disappeared forever without a trace. Ironically, this initial success of scientific plant breeding rested entirely on its newfound ability to select the best yielding single individuals from a wide range of farmer-selected populations, and combine them into a few elite varieties – a one-time opportunity which will never return.

A few decades later, the Green Revolution brought the same process to many parts of the South, although more by government intervention than by farmer choice. Here, the impact was much less complete. The Green Revolution package only targeted a limited number of crops and regions, and there was also considerable resistance to its adoption. As a result, on-farm seed management systems remain strong in many developing countries, and seed selection skills, now almost entirely lost among developed country farmers, are comparatively widespread.

In the early 20th century, much plant breeding was supported by governments, and farmer cooperatives were frequent actors alongside a large number of mostly small private breeding firms. Over time, seed companies have grown fewer and bigger. In the North, the seed business is now dominated by a handful of transnational corporations, almost all with their origins in the chemicals or pharmaceuticals sector, and the trend is the same in the South. These corporations have radically shifted the technological focus of the business, from basic Mendelian cross-breeding to various methods involving direct manipulation of cells or DNA, in particular genetic engineering. Although well over 90 per cent of the world's cropland is planted with non-GE seeds, probably over half of global plant breeding investments now go to genetic engineering projects.

The shift to corporate control has been facilitated by changes in intellectual property laws, which have gradually turned the genetic information contained in seeds into private property. Until the 1960s, farmers always had the right to reuse seed from their own harvest, and a breeder could always use any seed as a starting point for further breeding, even if it was a variety from a private company. Today, most commercial varieties are covered either by industrial patents, which allow no farm-saved seeds and no breeding use, or by plant variety protection which limits breeding use and only allows farm-saved seed as an optional exception. All member states of the World Trade Organization (WTO) – the vast majority of the world's governments – are now obliged to apply these limitations.

National seed legislation, in turn, limits the possibility to use any other seed than commercial varieties Most governments have variety registration and seed certification schemes, which usually make it difficult or entirely illegal to grow, market or use any seed which is not certified or does not have a registered owner.

Plant breeding techniques are also used as a means to block the reuse of seed by farmers or other breeders. First-generation (F1) hybrids, which dominate the market in maize and in many vegetable crops, are the main example of this.

Seeds and Breeding in Organic Agriculture – Current Situation

The IFOAM Basic Standards states two general principles regarding seeds:

- Species and varieties cultivated in organic agriculture systems are selected for adaptability to the local soil and climatic conditions and tolerance to pests and diseases.
- All seeds and plant material are certified organic.

In addition, it makes four recommendations:

- A wide range of crops and varieties should be grown to enhance the sustainability, self-reliance and biodiversity value of organic farms.
- Plant varieties should be selected to maintain genetic diversity.
- Varieties known to be suited to organic cultivation should be preferred.
- Operators should use organically bred varieties.

However, most of these general statements are not followed up by mandatory provisions. Regarding seeds, there are only two things that certification standards "shall require":

- that organic crops shall be grown from organically propagated seed, when available in appropriate varieties and quality, and
- that seeds or plant material from genetically engineered varieties are not allowed.

Virtually all organic standards worldwide, private as well as legislated, now contain provisions to the same effect.

In addition, there exists a draft IFOAM plant breeding standard, which has been under discussion for several years, but is not yet agreed. Its main content is a proposed positive list of acceptable breeding techniques.

The lack of more specific standards reflects the fact that organic plant breeding is still in its infancy. There are some dedicated organic breeding firms, mainly in Europe and North America, but they are all relatively small and only supply seed to a small fraction of the organic crop area. There are also a number of farmer networks, mainly in the South, which organize on-farm organic breeding based on traditional seed stocks, usually with some external technical input from NGOs or friendly academics.

For the most part, organic farmers depend on the same sources of seed as conventional farmers do in their region. In the North, this usually means commercial seed of mainstream varieties, sometimes organically propagated, sometimes not. The proportion of organically propagated seed varies greatly by crop and region, with the highest proportions in some countries in northwestern Europe and in cereals and other major field crops.

In the South, there are many regions where traditional on-farm seed systems are still the norm, which means that practically all organic farms use their own organically propagated seed, or locally available seed from other farmers In other parts of the South however, commercial seed dominates. Here, few if any farms use organically propagated seed, as there is usually very little or none on the market in developing countries. Often, it is even difficult to find seed that is not chemically treated.

Generally speaking, this situation makes it very difficult for most organic farmers to adhere to the general principles and recommendations of the Basic Standards. Typically, an organic farmer has a more limited choice of seeds than a conventional farmer in the same region. Few have access to seed from organic plant breeding, and usually only a limited number of the available conventional varieties are suitable for organic management. Unless they are able to use local seed from traditional systems, it is likely that organic farms often contribute less to crop genetic diversity than their conventional counterparts.

In many cases, the introduction of the mandatory requirement for organically propagated seed as is e.g. is taken up in the EU regulation for organic agriculture, is reported to have further reduced choice. Implementation varies widely, but many certification bodies and public authorities appear to interpret the requirement very narrowly, and make little allowance for the appropriateness of the varieties in other respects.

Seeds and Breeding in Organic Agriculture – From Principles to Practice

Organic agriculture has always developed organically. Starting from a set of simple fundamental principles, practice has gradually refined our thinking. From the beginnings in crop production, organic methods have been defined for most other parts of the agriculture and food chain. This process is now underway regarding organic seeds and breeding, but it is unevenly developed.

The part which is comparatively well developed is organic seed propagation. There is long practical experience of organic seed growing, and this is reflected by a clear set of rules in organic standards. This is not surprising, as the growing of seeds differs relatively little from the growing of other crops, and can draw from that experience.

The notion of organic plant breeding on the other hand is quite new. Actual practice is in an experimental phase, trying out how organic principles can be turned into workable plant breeding systems. Plant breeding is not primarily about growing plants, so analogies with organic crop production are only of limited value. A first version of a standard has been drafted and can soon be in use, but it is also at an early stage and will need to evolve as practical experience accumulates.

However, in several respects the link from organic principles to plant breeding practice has proven quite straightforward. In the wording of the IFOAM Principles there are several key concepts which apply quite directly, in particular the following six:

- The integrity of living systems
- Immunity, resilience and regeneration
- Working with and emulating ecological systems
- Adaptation to local conditions, ecology, culture and scale
- Maintenance of genetic and agricultural diversity
- Socially and ecologically just management of resources

Building on practical experience, the following characteristics are now widely mentioned as important elements that distinguish organic plant breeding from conventional:

- Plants must always remain fertile and reproduce naturally
- All field selection takes place under organic management
- Breeding techniques on whole plant or population level are the basis, in order to allow the self-regulation of natural systems to function
- Molecular level breeding techniques are not used
- Cell level breeding techniques are used very restrictively
- A more evolutionary approach, moving away from pure-line breeding toward greater genetic flexibility, to allow continuous adaptation of seeds in the field
- Different breeding priorities, notably in areas like nutrient uptake efficiency and weed suppression
- Different approach to resistance breeding, giving priority to stable, polygenic field resistance or tolerance, not fragile single-gene solutions
- Different forms of social and economic organization, built on interaction between breeders and farmers, sometimes extending also to users of the harvest products
- Open exchange of genetic material

Key Issues

The following sections identify a number of key issues which require special attention and action by the organic movement.

- **ADAPTATION AND EVOLUTION**

The approach to local adaptation is probably where an organic plant breeding philosophy differs most fundamentally from the current mainstream. A typical plant variety today is a highly homozygous "pure line", which means that it is genetically "locked" and has little potential to evolve in the field. It is also bred to perform best under optimal conditions in terms of nutrient and water availability, temperatures, weed competition etc. In other words, it is designed on the assumption that the environment should be adapted to the demands of the plant, not the other way around.

Organic breeders aim instead to provide a high level of genetic adaptability, so that seeds can to some degree continue to evolve in response to environmental factors. This is not a new idea, but builds on a small but important minority paradigm which has always existed in plant breeding.

Adaptability can be achieved in various ways. A pure line variety can be designed to be more heterozygous – have more genetic flexibility. Alternatively or in addition, a variety can contain several slightly different genetic lines, a so-called composite or multiline variety. Or, to maximize adaptability, the idea of a fixed variety can be left behind altogether and breeding be done on whole populations, not on individual lines. In all these cases, seed selection and propagation must of course be done on-farm or in the immediate region, in order for the adaptation to be of any relevance.

From an ecological perspective, there is little doubt that such evolutionary approaches, in particular various forms of population breeding, are the best way to ensure optimal adaptation and long-term sustainability of seed systems. Population breeding can very closely emulate the evolutionary dynamics of natural plant populations, while maintaining high and stable production. It is also a simple and time-tested method. Practically all traditional on-farm seed systems have been built on maintaining populations rather than fixed varieties.

There are however formidable practical and legal obstacles to reintroducing a higher degree of genetic variability into seed stocks, and in particular to population breeding. In most countries, the legal definition of a plant variety is so narrow that even multiline varieties can be difficult or impossible to legally register and use, and populations fall entirely outside the rules. Also, the whole financing system presently supporting plant breeding is designed for uniform pure line varieties only.

- **BREEDING TECHNIQUES**

Much work has already been done to define what breeding techniques are appropriate for organic plant breeding. There is broad agreement on two general criteria:

- organic breeding must stay within the limits of natural reproduction, and
- it should primarily work on the level of the whole plant, and not directly interfere at cell or molecular levels.

Both criteria follow directly from the principle of Health, referring to the integrity of living systems.

In the IFOAM Basic Standards these criteria have already been applied in one specific case, the general prohibition of genetic engineering and closely related techniques such as cell fusion. These provisions need to be reviewed to clarify that protoplast fusion is also included in the definition of genetic engineering.

However, the draft standard on organic plant breeding, intended to provide a more complete and positive definition of organic plant breeding techniques, has not yet been agreed. In order to support the development of organic breeding, this standard should be finalized without further delay, so that certification of breeders and their products becomes possible. There are some outstanding questions regarding where exactly the line should be drawn in terms of allowed techniques. These differences should be possible to settle with the help of established mechanisms such as time limits, transition periods and derogations. As usual when a new area is introduced into organic standards, a first version will have to start at a basic level and then evolve as the field matures.

The current draft should also be expanded to include some other aspects important to the definition of organic breeding. To base certification only on the use or non-use of certain techniques is too narrow. For example, it should be required that organic breeding is conducted in direct interaction with organic farming and that seeds from organic breeding must always be available for on-farm propagation and for further breeding.

- **TRADITIONAL SEEDS**

Much of organic plant breeding is connected to traditional on-farm seed systems or builds on genetic material from traditional sources. This is especially true in the South, where there exist a number of well-established farmer networks which combine conservation of traditional seed stocks with on-farm breeding. Results are frequently impressive, with organic yields in major crops like rice and maize that are fully comparable with yields from commercial varieties under high external input management.

That traditional seeds provide an excellent starting point for organic breeding is not surprising, as the two systems share many core characteristics. In particular, traditional seeds usually conserve a greater genetic variability than modern commercial varieties, and most often they have been selected under low input management practices which are very similar to organic systems. Also, the social organization of traditional seed systems can provide useful models for the interactivity between breeding and farming, which has been identified as one key component of organic breeding.

However, traditional seed systems, where they still exist, can also provide a fully viable alternative to commercial seed in their own right. In many cases, traditional seeds can be a better choice for organic farming than commercial seed from conventional production, or even than organically propagated seed of mainstream varieties. Today, this possibility seems often to be overlooked. This may partly be because of a cultural bias, as both standard setting and certification bodies are overwhelmingly rooted in the North, where traditional seed systems are no longer a major factor in agriculture, and traditional seeds are often regarded as only of historical interest.

It is important to note that nothing in the IFOAM Basic Standards specifically limits the use of traditional seeds in organic agriculture, regardless whether the source is conventional farming, household gardens, genebanks or non-cultivated land. The only limitation is the general rule about preference for organically propagated seed, which applies in the same way as for any other seed. In many countries, however, national seed legislation does limit or even prohibit the use of traditional seeds by requiring variety registration and/or seed certification for any crops that are marketed (see separate section below).

Throughout the organic movement, the existence and value of traditional seeds needs to be better taken into account, especially when formulating and interpreting organic standards. In particular, organic certification bodies active in the South need to improve their procedures so that traditional seeds are not discriminated against.

▪ PRIVATIZATION OF GENETIC INFORMATION

A decisive factor behind the decline of public sector plant breeding and the rise of plant breeding transnationals and therewith the decrease in genetic variety has been the creation of intellectual property laws which privatize the genetic information contained in seeds.

In traditional on-farm seed systems, there may be private ownership of the physical seed used for planting, but never of the genetic code in the seed itself. For a long time, the same principle continued to apply in scientific plant breeding. Farmers who bought the new varieties were free to reuse part of their harvest as seed for as long as they wished, and a breeder could make crosses with another breeder's varieties without any restrictions.

Although private companies frequently lobbied governments to allow patenting of seeds, free exchange remained the rule until the 1960s when plant variety protection, a copyright-like form of legal protection for plant varieties, was introduced by an international treaty, UPOV. The UPOV system originally only gave a breeder exclusive rights to the commercial propagation of a variety. Once sold, the seed could still freely be saved and reused by a farmer, or used by another breeder.

Over time, the UPOV system has gradually become more restrictive. In its current version, farm-saved seed is only allowed as an optional exception, and access for breeding is subject to conditions. In the next revision of UPOV, farm-saved seed will likely be prohibited altogether, and use by other breeders only allowed after a variety has been on the market for 10 years.

In addition, industrial patents have also started to be used on plants in many countries, first on genetically engineered varieties only, but now increasingly also on conventionally bred seeds. Patents allow no farm-saved seed at all, and no use by other breeders unless agreed with the patent owner under a formal contract.

Until the 1990s, those systems were used mainly in the developed world, but with TRIPS, the agreement on Trade-Related Aspects of Intellectual Property Rights – part of the 1994 WTO treaty – intellectual property protection of seeds became obligatory for all member states. The result is that most developing countries now also provide patents or UPOV protection for seeds, or both.

Privatization of the genetic information in seeds obviously conflicts with core organic principles. It is not a socially or ecologically just management of resources, and it does not respect the integrity of living systems. It is also directly harmful to the development of organic plant breeding, which depends to a great extent on continuous farm-level selection and exchanges of genetic material between breeders and farmers.

For consideration is whether standards should be amended to prohibit any use of seeds covered by forms of intellectual property protection which do not allow on-farm seed propagation or access for further breeding

- **SEED LEGISLATION**

Most countries have some form of seed legislation regulating seed quality testing and variety registration. These systems are sometimes voluntary but often mandatory. While the original intention was to provide farmers with government-sponsored quality control and prevent sales of substandard seed, many seed laws have also developed into a secondary protection system for the seed industry. It interlocks with UPOV plant variety protection and is often handled by the same government agencies and integrated into the same national legislation.

Where variety registration or seed certification is mandatory, the system effectively blocks the use of any other seed. Unregistered or uncertified seed cannot be sold, and in some cases not even exchanged or distributed for free. This severely limits the use of seeds from traditional on-farm systems, and will become a major problem for the further development of organic breeding. In some countries, simplified registration systems have been created to allow some sales of "conservation varieties", but these separate systems are usually strictly limited to small amounts and non-commercial uses, and not relevant for full-scale farm use.

In order to be registered as legal to market, a variety must usually undergo testing to prove its agronomic value, but also to show that it is sufficiently distinct, uniform and stable (DUS) to be reliably distinguished from other varieties on the market. This DUS test – also needed to get UPOV protection – requires a level of genetic homogeneity which goes far beyond what is needed from an agronomic point of view. It only serves the need for seed authorities to easily confirm the identity of the variety when testing samples. The DUS requirement makes it difficult or impossible to register and sell seeds bred for a higher degree of genetic variability.

Other problems with variety testing have also been identified. For example, the tests tend to underestimate the value of varieties with polygenic disease resistance, which may fail tests because they are not completely free of the disease. The fact that a polygenic resistance is usually more stable and long-lasting than a single-gene resistance is not taken into account. Tests are also conducted using high levels of artificial fertilizer and pesticide inputs, which favors varieties performing well under optimal conditions, while varieties adapted to lower input conditions may fail the test.

Cost is another problematic factor with variety registration systems. Variety testing is usually paid for by breeders' fees, which means that the cost adds to the price of the seed. This is a strong incentive to produce fewer and more standardized varieties, and thus reduces choices in the market. For small markets like the organic sector the cost may be prohibitive.

Seed certification systems should in principle be voluntary, or alternatively allow different classes of registration to accommodate all types of seed.

▪ ORGANIZATION AND FINANCING OF BREEDING

Organic plant breeding differs from conventional not just in terms of technology, but also in social and economic organization. The present commercial seed system reduces the farmer to the role of customer only. Organic plant breeding requires a more interactive relationship between breeder and farmer. The level and format of interaction can vary, from an active involvement of farmers in variety trials and selection, to completely farmer-managed on-farm breeding, where breeders serve as technical advisors. Other actors in the food chain may also have a role, for example when the final use of the crop requires specific qualities, such as in baking or other processing.

Mainstream plant breeding is now financed almost entirely through royalty payments based on UPOV plant variety protection or patents. Organic breeding will need to seek other solutions. This is partly because it aims to reduce the privatization of genetic information, and thus will not participate in the efforts to prohibit farm-saved seed and force farmers to higher royalty payments, but also because the organic seed market will remain relatively small in the near and mid-term, so that seed sales alone will not be enough to fully finance the necessary breeding work.

Interactive models of organization however offer new possibilities. As seed development becomes more of a joint effort, costs can be shared between all links in the food chain, from breeders to final consumers, in new ways. Farmer participation in breeding also means that some of the cost can be covered by contributions in kind. In addition, participatory breeding schemes have been shown to be a more cost-effective organization model than breeding in dedicated research stations.

But there is also a strong argument for some public support. Organic plant breeding is an investment in a more sustainable future agriculture. This is a public good which should not need to be financed by the pioneering organic sector alone.

- **ORGANIC SEED PROPAGATION**

The IFOAM Basic Standards require that organic crops shall be grown from organically propagated seed, if available in appropriate varieties and quality. This wording was intended to take into account both the farmer's need for a sufficient choice of reliable seeds with suitable properties, and the need to support the developing market for organically propagated seed.

In practice, the implementation of the provision appears too often to be unbalanced. Some certifiers and government agencies require that organically propagated seed is used even if there are very few varieties available, and regardless whether these are regarded as appropriate by farmers, or of normal quality.

In several European countries, where organic agriculture is regulated by legislation, official databases have been set up that prescribe exactly for which crops and varieties organically propagated seed must be used. In some cases, it is regarded as sufficient if one single variety is available as organically propagated.

What is an appropriate variety for a specific farm and crop is a complex question. The choice has to do not only with climate, soils, prevalent plant diseases and other local growing conditions, but equally much with intended use and market preferences, with management practices and technical equipment, and with the farmer's overall vision of how the ecological balance and biological diversity of the farm should be maintained and strengthened.

For consideration is whether the final judgment of what is an appropriate variety must always remain with the individual farmer. Site-specific management of farms is one of the most fundamental principles of organic agriculture. Moving decisions about seed choices from farmers to certifiers or government agencies clearly violates this idea.

The importance of organic seed propagation must also not be overestimated. The added value of organic propagation consists in the reduced environmental impact when the seed is grown. As the amounts of seed in most crops are small in relation to the harvest, that effect is limited. In terms of the overall environmental effect, the value of starting an organic crop with a genetically well suited seed is usually much higher than the value of starting it with organically propagated seed. The positive environmental impact of a better harvest of higher quality, which replaces more conventional produce on the market, very soon cancels out the negative environmental impact of growing a small quantity of seed conventionally. This is even truer in crops where organic farmers buy new (conventional) seed only one year out of two or three, and use farm-saved (organic) seed the remaining years.

It is sometimes argued that strict administrative policies regarding organically propagated seed, of the type now seen in Europe, are a necessary first step towards organic breeding. Judging from the European experience, this is doubtful. Most of the organically propagated seeds now available on the European market are of mainstream commercial varieties, and the system so far does not seem to create any specific incentives for organic breeding.

What seeds organic farmers freely choose to use is the only reliable long-term guidance for the business decisions of breeders and seed producers. With good market research – or better still, direct cooperation with organic farmers – to get a correct picture of what varieties are widely preferred, seed producers will know what to propagate organically. Most organic farmers will not hesitate to pay a premium for seed which perfoms well for their specific purposes, especially if they get organic propagation in the deal – but few will want to pay for organic propagation in a variety which does not fit their needs

Likewise, farmer choice must be the guide for all actors who enter into breeding specifically targeted to organic farmers – whether they are dedicated organic breeding firms, mainstream companies who want to adapt existing varieties, or participatory breeding initiatives. In all these cases, organic propagation will be integrated already from the breeding stage.

In order to clarify these issues, the relevant provisions in the Basic Standards must be reviewed. First, the terminology should be revised to so that the term "organic seed" is no longer used for seeds which are merely propagated under organic management, but only for seeds which are both the product of organic breeding and organically propagated. Second, it should be clarified that organically propagated seed should always be used when available in the variety a farmer chooses to use, but that the choice of variety is always up to the farmer, even if this means not using organically propagated seed.

References / background reading

HISTORY OF PLANT BREEDING

Jack Kloppenburg, *First the Seed. The Political Economy of Biotechnology,* Madison, WI: University of Wisconsin Press, 2005.

Probably remains the best historical introduction. Focus mainly on North America, but a critical perspective which is generally applicable and a wealth of references.

ORGANIC BREEDING

The website of the European Consortium for Organic Plant Breeding (www.ecopb.org) contains documents on most aspects of organic breeding (pls note that the navigation is a little confusing: once you choose a category on the "Publications" page, you need to use the tiny "forward" button at bottom to reach the following several pages).

Some specific recommendations:

Edith Lammerts van Bueren et al, *Sustainable organic plant breeding*, Driebergen: Louis Bolk Instituut, 1999.
http://www.ecopb.org/09/5036.pdf

A general introduction to the concept of organic plant breeding.

Plant Breeding Techniques. An Evaluation for Organic Plant Breeding, Frick: FiBL, 2001.
http://www.ecopb.org/09/plant_breeding.pdf

Thorough, systematic, yet quite accessible for the non-breeder.

A M Osman et al (eds), *Different models to finance plant breeding. Proceedings of the ECO-PB International Workshop on 27 February 2007 in Frankfurt, Germany,* Driebergen/Frankfurt: European Consortium for Organic Plant Breeding, 2007.
http://www.ecopb.org/09/proceedings_070227.pdf

A first look at alternative financing models.

Dominique Desclaux and Marianne Hédont (eds), *Proceedings of the ECO-PB Workshop on Participatory Plant Breeding: Relevance for Organic Agriculture*, held in Domaine de la Besse (Camon, Ariège), France, 11-13 June 2006, Paris: ITAB, 2006.
http://www.ecopb.org/09/proceedings_060613.pdf

See in particular the contributions by Ceccarelli and by Bonneuil and Demeulenaere.

TRADITIONAL SEED SYSTEMS

Good documentation of traditional seed systems is difficult to find, especially regarding how they work and continue to develop today. The academic literature tends to focus on historical aspects.

LEISA Network archives
http://www.leisa.info

Since more than 20 years, the LEISA project (Low External Input and Sustainable Agriculture) has documented practical experiences of sustainable peasant farming. Their large archive is now freely available on the internet. A Google search for "seed" on the whole site will yield a number of articles related to traditional seed.

GRAIN Growing Diversity Project
http://grain.org/gd

With a number of partners, GRAIN organized a global project to document and share experiences between community initiatives for local management of biodiversity important for food and rural livelihoods. Ended in 2002, but full documentation remains available on website.

Charito P Medina, *Rebuilding Small Farmers' Resilience*, Presentation at International Conference on Organic Agriculture and Food Security, FAO, Rome 3-5 May 2007.
ftp://ftp.fao.org/paia/organicag/ofs/04-Medina.pdf

A concise overview of MASIPAG in the Philippines, a farmer network which has successfully revitalized traditional seed systems, developed their own breeding, and combined this with fully organic management.

INTELLECTUAL PROPERTY AND SEED LEGISLATION

The GRAIN website is a good starting point for all issues related to legal and economic control over seeds (and biodiversity in general).

The end of farm-saved seed? Industry's wish list for the next revision of UPOV, Barcelona: GRAIN, 2007.
http://www.grain.org/briefings_files/upov-2007-en.pdf

A well referenced analysis of the current IPR situation regarding plants. Focus on UPOV protection, but in the context of patents and more.

Niels Louwaars, "Biases and bottlenecks. Time to reform the South's inherited seed laws?", *Seedling*, July 2005, Barcelona: GRAIN.
http://www.grain.org/seedling_files/seed-05-07-2.pdf

A general introduction to seed laws, with special focus on the situation in developing countries. This whole issue of Seedling was on seed laws, and also includes specific coverage of recent legislative changes in various African and Latin American countries.

Biodiversity Rights Legislation
http://www.grain.org/brl/

A database of biodiversity-related legislation in a number of countries worldwide: patent laws, PVP and seed laws, and much more.

ORGANICALLY PROPAGATED SEED

Challenges and Opportunities for Organic Agriculture and the Seed Industry, *Proceedings of the First World Conference on Organic Seed*, Rome July 5-7, 2004, Bonn: IFOAM.
http://shop.ifoam.org/bookstore/product_info.php?cPath=64_65&products_id=70

Several presentations dealing with the effects of the requirement for organically propagated seed. For seed industry viewpoints, see in particular the contributions by Peerenboom, Haitsma, and van der Zeijden. For farmer viewpoints, the contributions by Echeverria Hermoso, Micheloni and Giubilato, and Ramos Garcia et al.

Organic, non-treated and non GMO seed and planting material. Tanzania, Uganda and Zambia, Bennekom, NL: EPOPA, 2005.
http://www.grolink.se/epopa/Publications/EPOPA%20Seed%20report.pdf

An analysis of the practicality and consequences of requiring organically propagated seed in three African countries.

Zinta Gaile, *Organic seed propagation: Current status and problems in Europe*, Seminar on Environmental friendly food production system: Requirements for plant breeding and seed production, Seminar May 31-June 3, 2005, Talsia, Latvia.
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A very critical look at the consequences of requiring organically propagated seed, in particular effects on biodiversity and small farmer livelihoods.