

Present and future system organisation of organic plant breeding

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Introduction

Financing plant breeding is in most market economy countries a private matter, and the expenses are covered by royalties for approved varieties. At least in Europe, a huge proportion of the breeding expenses are allocated to meet the requirements for the official approval of the varieties. In such a system, marketing a few varieties with a huge market potential is more profitable than marketing many varieties with each relatively less market share. During the last 150 years of modern plant breeding, plant breeding has to increasing extent developed into a search for varieties that are suitable for huge areas, rather than varieties that are suitable for specific targets. As a consequence of this development, the breeding activities are concentrated on still fewer companies concentrating on still fewer crops.

Organic farming only covers a few percent of the arable land, and within organic farming there are more differences between farms and growing conditions in terms of nutrient availability, weed pressure etc. The interaction between the varieties genetic constitution and the environment is bigger in organic systems, and therefore, the best conventional varieties are not always optimal for organic systems, and the same variety is not optimal for all organic conditions. Hence, the financial system for plant breeding in the market economy is not suitable to develop varieties that cover the needs of organic farming.

Organic farming need either many different stable varieties able to fit into the many different niches in the organic systems, or varieties or populations with a certain plasticity enabling them to adapt to the different conditions. Also, a bio-diverse crop is preferable in an organic system as it will promote interaction with the surrounding nature and increase overall biodiversity of the system.

To have a variety approved in Europe, it needs to meet the key criteria of UPOV, which means that the variety need to be uniform, stable and unique. These criteria contradict the basic needs for organic farming. The uniformity demanded by UPOV is the opposite of the diversity aimed for by organic farming principles. The goal for organic farming is to use the biodiversity to exploit the system in order to minimize losses. Uniformity is mono-cropping suited for high input conditions. Stability is unsuited for a variety that are able to adapt to different conditions. Novelty and uniqueness is only applicable for varieties that are stable and uniform, and the claim increase the expenses for official approval and thereby decrease the number of approved varieties.

The goal for organic breeding is therefore unfit within the UPOV system, and organic breeding need to find ways of acting within alternative legal frameworks.

Plant breeding is basically a profitable business for the society, as improved yield and quality often will return the cost for the plant breeding investment. However, in a private economy the benefit of plant breeding activities goes to the farmer, but the cost is paid by the plant breeder. To compensate the breeders costs, the farmer pays a royalty to the breeder for the use of his varieties. If the royalty gets too high, the farmer will often use home saved seed in order to minimize costs. There is therefore a limit as to how high the royalty can be, and breeding is therefore only profitable if a variety is successfully sold for huge areas, which is only possible

for conventional use in the major crops. At present, the royalty are not able to cover the cost of an organic plant breeding program, even though it is likely to be profitable for the breeder-organic farmer system. This dilemma can hardly be solved within a purely private economy system, unless the organic breeder and the organic farmer has common economical interest, which means that the breeding company should be owned, or supported by the farmers in other ways than by purely commercial royalty payments.

If organic farmers should support a plant breeding program for organic farming, they need to be sure that the investment benefits themselves. Therefore guidelines for organic plant breeding is needed. So, what is organic plant breeding?

Defining organic plant breeding

There can hardly be a strict definition for organic plant breeding, but there are some criteria which makes some breeding activities more relevant than others.

Criteria 1: Organic plant breeding is breeding **to** organic farming. Organic plant breeding is breeding of plant intended to be used by organic farming. This means that the breeding should have the specific intention that the breeding product should be used by organic farmers. GMO-breeding is of course excluded, as GMO-crops cannot be used by organic farmers, but most varieties currently used by organic farmers today derive from breeding programs for conventional farming, but are used by organic farmers in lack of alternatives.

Criteria 2: Organic plant breeding is breeding **for** organic farming. The aim of organic plant breeding is not just to market plant varieties that can be sold to organic farmers, rather the purpose is to solve problems that are relevant for organic farmers. The breeding target should be made not only on basis on a market analysis on what can be sold to the organic farmers, but should also be made on an analysis on what are the most relevant problems to be solved. These two things are not always the same, especially not in a situation, where there are very few stakeholders in the market. Often the best variety will be sold, but the best variety is not necessarily a good variety, if all other varieties are also suboptimal, developed for conventional conditions. A breeder do not need to try to solve a specific organic problem, if there are no other companies that have a competing product, which is normally the case in the market for organic plant varieties.

Criteria 3: Organic plant breeding is breeding **within** organic farming. Organic breeding should take place on organic fields or under similar organic growing conditions. The relevance for this criteria is not only that this will ensure that selected plants will grow well under organic conditions, but the criteria is also needed to safeguard the organic integrity. Some inbred lines for example can hardly survive under organic conditions, whereas hybrids produced from these inbred lines can. However, it violates the organic integrity if the varieties used rely on conventional inputs during the breeding or multiplication process, which are not allowed in organic farming. Also seed borne diseases are often a problem in long term organic propagation, even they are often not a problem if grown only a few years organically.

Future perspective for development of an organic plant breeding system

If the criteria for organic plant breeding are met, I believe organic farmers should invest in organic plant breeding activities. It should be tried to attract public and non-profit funds, or even profit funds as well. No matter how the breeding is established, the situation will be economically difficult, and low cost methods are needed. However, there are relevant low cost methods that are well suited for establishment of organic plant breeding.

Composite cross populations are shown to be compatible with pure line varieties in wheat (Wolfe *et al.* 2006) and in combination with the principles of participatory plant breeding, the organic farmers could take control of a major part of the supply of varieties for organic farming. Using populations of selfing cereals will meet the organic aim of within crop diversity as an alternative to monocropping. However, it needs development of a new system for demand and supply of seed. Seed of populations can be exchanged, but cannot be sold on the regular market for certified seed, as this would violate the official seed regulation in most countries. In conventional agriculture, seed has become an input from outside like fertilizers, energy and feed, but in an organic system with own plant breeding based on diverse populations, the seed will become ware, which the farmer himself alone or in cooperation with colleagues are responsible to take care for, like the fertility of his soil. The breeder will in such a system not be an external supplier of a commodity, but will rather act as a consultant, advising for the multiplication, maintenance and selection for relevant traits. Populations can be created and composed locally or in relevant branch organisations, targeted for specific traits according to the local climatic, pathogenetic or market-specific needs.

To make such a system work in practice, there is a need for research and technology development that focus on mass selection of diverse populations rather than breeding techniques for selection of genetically homogeneous and stable pure line varieties.

In Denmark, a breeding program has started aimed to develop populations of spring wheat, purple wheat, winter oat, black seeded and naked barley, bunt resistant wheat and spelt, and another program aims to utilize old Danish conservation varieties in organic farming. These programs are supported by the Ministry of Food and Agriculture (FødevareErhverv).

References

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