

Green Breeding



New models for plant breeding: Key elements for collaboration within the food chain

Introduction

As the financial threshold for cost-effective breeding continues to be raised, increasingly more crops are becoming 'too small' for breeding. For example, an arable crop such as oats is nowadays considered unprofitable by some commercial breeding companies. For many grain legumes, breeding programmes were cut back years ago. And among vegetables, breeding programmes for minor crops such as black salsify and parsnip are gradually being abandoned. The long-term consequence is that production of these crops will become

increasingly difficult, because the available varieties will not be adapted to future changes in the cultivation system (new methods, new diseases, etc). The question is how to develop alternative crop breeding models for small markets.

For the organic production chain, this question is far from new. Organic crop production requires varieties that, among other things, are adapted to lower nutrient inputs and that can be grown without pesticides. For commercial breeding companies the (as yet) limited scale of organic agricul-

ture is a significant bottleneck for investing in breeding programmes aimed specifically at organic production. After all, they have to recover their investment costs through the sale of seeds, and this requires a minimum sales level for each crop. The result is a vicious circle that is not easy to break. This is not only a problem for the organic sector, but increasingly also for minor crops within the conventional sector.

To address this problem, the Louis Bolk Institute (LBI) is developing innovative approaches to funding and organizing crop breeding for small markets. For various arable crops the LBI has initiated collaborative breeding programmes that are based on a multi actor approach, involving not only commercial breeding companies but also other important players within the food chain, such as processors and traders. Each of these initiatives is tailored to the specific structure of the sector in question, and thus cannot easily be 'translated' to other crops. To facilitate this 'translation', we have compared and analyzed various breeding initiatives for organic production of potato, spring wheat and cucumber. In this project, which was funded by the Dutch Ministry of Economic Affairs, we have identified various key elements that are crucial for the success of such initiatives (see box).



All food chain partners together in the field



Key elements

- All food chain partners must feel ownership of the problem (for example, of *Phytophthora* in potato; this resulted in the Bioimpuls project).
- In general, the greater the economic importance of the crop, the sooner the problem is collectively recognized and prioritized.
- Complexity of the food chain: the more players with different business cultures and farming practices, the more difficult it is to get everyone committed to a common goal.
 - Collaboration has to be initiated within the food chain.
 - A (neutral) facilitator is needed who recognizes and balances the different interests of all parties involved.
 - It should be noted that the historical context and institutional organisation of plant breeding differs significantly among crops and sectors. In the Netherlands, potato growers have always been directly involved in selection and breeding. In spring wheat, however, crop production and crop improvement are entirely separate activities. Compared to wheat and potato breeding, vegetable breeding is more competitive, and therefore more often takes place 'behind closed doors'.
- Crop specific traits play an important role.
 - Growers can play a larger role in crop improvement of vegetatively propagated crops and open-pollinated varieties, than in improvement of F1-hybrids.
 - In some crops it is easier to select for certain traits than in other crops.
 - Quite a few vegetable crops are biennial, leading to longer breeding cycles.
- New forms of collaboration deserve policy support.
 - Crop-specific study groups can be crucial to bring together different players (breeders, growers, traders) and to identify the key elements for successful collaboration.

Types of breeding programmes

Together these key elements determine the possibilities for new models of plant breeding. These possibilities vary between crops and sectors. Growers in the vegetable sector are usually less involved in selection and seed production than in the arable sector, where crops such as wheat and potato directly provide new seed material. Moreover, there is more specialization in the vegetable sector, and for many vegetable crops (e.g. lettuce, cabbage) seed production requires extended cultivation periods. As a result vegetable growers have little affinity with seed production, and even less with crop breeding.

Starting up new breeding companies

In a time when many commercial breeding companies are merging or being bought up, the start up of new companies is certainly noteworthy. Within the context of organic agriculture two young companies are particularly worth mentioning: Bingerheimer Saatgut AG in collaboration with the Kultursaaf Foundation, and De Bolster (see boxes).



For both companies it is crucial to be attuned to the needs of the sector and be a trusted partner in the market chain. Therefore they work closely together with growers, for example in on-farm trials of promising new varieties, or in seed production.



Existing breeding companies could adjust their breeding programmes in various ways to accommodate breeding for small markets such as organic crop production:

Re-thinking the prioritization of plant traits

The prioritization of crop variety traits is often not the same for organic versus conventional production. As a first step, existing breeding programmes could give more priority to traits that are important for organic production, such as growth vigour, nitrogen use efficiency and resistance against multiple diseases. This could lead to different choices regarding parent lines and selection at an early stage of the programme.

Changing the organisation of selection programmes

Existing breeding strategies could be adjusted, for example by involving growers at an early stage in pre-screening promising varieties. During the workshops that were part of this project many growers indicated that they would be very interested to accommodate such trials. Breeding companies are also realizing that they could gain from grower participation, and that it offers opportunities for future sales. But they must make the first move, and adjust their policies.

Improving communication

Communication between breeding companies and growers about potential improvements of varieties is often done through

sales representatives. As a result, subtle yet essential information on desired and possible (innovative) crop improvements, particularly in relation to organic production, does not reach the breeders. Shorter communication lines are therefore needed. Opportunities to improve communication are farm-based trials, and drawing up crop profiles in the field together. These

interactions will allow growers to clearly communicate to the breeders what kind of variety they need, and what crop traits are important in their cultivation system.

Collaboration initiated by other

Bingenheimer Saatgut AG and the Kultuursaaf foundation

Bingenheimer Saatgut is a German company that produces and sells biodynamic and organic vegetable seeds of existing and new open-pollinated varieties. The affiliated seed growers (about 100) each take care of seed production for one or more crops. About 20 of them (including two growers in the Netherlands) are also developing new open-pollinated varieties of various vegetable crops. For this work they receive financial support from the Kultuursaaf Foundation. Kultuursaaf takes care of registration of the new varieties, but does not claim breeders' rights. Anyone wishing to trade these new varieties signs an agreement with Kultuursaaf and pay a voluntary fee. In practice, most of these varieties are traded through Bingenheimer Saatgut AG. Crop breeding through Kultuursaaf is funded through donations and voluntary fees.

De Bolster

Before its take-over, seed company De Bolster focussed on organic seed production for amateur gardeners. The new owners of De Bolster are also targeting professional growers; their aim is to develop new varieties that are suitable for organic production. They started this work in 2004 and currently employ three full-time plant breeders. The focus is on pumpkin, courgette and tomato, for which various new varieties have been brought onto the market. Selection work is carried out under organic cropping conditions. The main bottleneck for start-up companies such as De Bolster is the high development costs of new varieties. These high costs are due to the fact that it usually takes at least 8 years to develop a new variety.



In addition to commercial breeders, other players in the food chain can also help to make crop breeding for small markets possible. It is important that such initiatives are taken within the food chain, and that they build on existing products. During our project workshops the following possibilities were suggested:

Creating win-win situations

Collaboration is based on bringing together areas of expertise, which benefits all partners in the food chain. To keep everyone committed, there has to be an economic profit for all parties involved. A case in point is the development of 'club varieties' such as Tasty Tom tomatoes. Breeding of these varieties is funded by a premium on the wholesale or retail price of the product. However, this concept can only be applied in 'closed chains' where all investment costs can be recovered.

Coordination at the European level

Many crops with a small market share in the Netherlands also have a small market share in other European countries. To develop better varieties of these crops, breeding objectives should be coordinated with partners from these countries. A level playing field in Europe is particularly necessary with regard to the use of organic seed material, which is more expensive than conventional seed. It is often difficult to reach agreements with international (supermarket) chains because these are primarily focussed on price and always look for the cheapest alternative.

Future oriented: collaboration and communication

There are also crops for which none of the abovementioned options offers a solution; for example when marketing perspectives are not sufficiently positive in the short term. However, there are always some growers who want to invest time and effort in selection. For example, many farmer-breeders involved in potato selection are primarily driven by enthusiasm and passion for their crop, rather than financial motives. To foster collaboration between breeders and growers in relation to other crops, more attention must be paid to communication, particularly to developing a common language and mutual understanding. This can be achieved through crop breeding courses for growers. An alternative option is a collaborative association of farmer-breeders, such as Kultursaat in Germany. To form and maintain such associations requires a common objective and vision. These forms of collaboration are most suited for breeding of vegetatively propagated crops and open-pollinated varieties.

Food chain approach plant breeding:

This project was conducted in the frame of Green Breeding by Edwin Nuijten, Leen Janmaat, Edith Lammerts van Bueren, Louis Bolk Institute.

Research Programme Green Breeding

The research programme Green Breeding (2010-2019) focusses on breeding of varieties that can cope with less nutrients and water and on resistance breeding to avoid pest and diseases. The research is on potato, leek, spinach and tomato. Next to those projects also some pilot studies are conducted on e.g. chain-approach in breeding and lupine breeding. This programme is financed by the ministry of Economic Affairs including a minimum of 33% in-kind or in-cash contribution of involved companies.

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