About de Bolster

(by Bart Vosselman, Loes Mertens, Bertille Gieu Arbaret)

WHO ARE WE?

The Bolster is a small Dutch family company, we produce and select organically certified varieties of vegetables and flowers. Our company is located on the farm named "Immenhof" in Epe, in the heart of the nature area "de Veluwe". The farm has been producing organic vegetables for the local population since 1983 until seed production began - in 2007. Caring for the environment and the population, is our goal. We offer traditional varieties of flowers and vegetables to home gardeners. According to us seeds are very important because it is part of our cultural heritage, we aim at maintaining and sharing it. "Small is beautiful", but we also want farmers to have the freedom to choose for tasty, organic, good yielding and adapted varieties. In the actual situation, farmers have only access to few varieties supplied by multinational seed companies. Since 2002, originating from personal initiative, an independent program of plant selection was set up at the Bolster. Since then, we select varieties in organic farming under conditions of low input. A traditional approach based on field observation is used. We work directly in relation with farmers, researchers and consumers to obtain the most suitable varieties. Seeds are the basis of any agricultural system. Our work has an important role for the viability of the organic sector and food security.

THE ROOTS AND GROWTH OF THE BOLSTER

The Immenhof is a well-known farm in the Veluwe, where hundreds of people regularly came to buy tasty and non-chemically treated vegetables and flowers. Nevertheless in 2002, Bart and Elly Vosselman decided to stop the production of vegetables and flowers. In 2005, they joined forces with Frank and Patrick. Frank is their eldest son, and Patrick worked on the farm with them since he was 15 years old. Together, this team of four took over the company de Bolster. The Bolster existed since 1978 and was located in Kiel-Windeweer in Groningen. They produced a big diversity of biodynamic vegetable, herb and flower seeds.

Since the Bolster was taken over by the family Vosselman, many new things happened. In 2007 the company moved to Epe. Ever since it has not stopped growing. In 2010 we were able to construct a new building. It now houses the new machines to sort, clean and dry the seeds. Thus, we can work in a more efficient and professional way. This building has also enabled us to offer better working conditions to ours workers (more space, not so cold in the winter). The number of employees is growing and has since 2007 gone up from 4 to 14. Throughout the year we also work with many students and interns. Through the years, the income rendered through seed production has permitted to invest more in research activities.

WHY DID WE CHOOSE FOR ORGANIC?

Bart Vosselman, the senior farmer-researcher explains: "Since my childhood I have a distaste for pesticides. At the time of my father's farm (this is 40 years ago) I could not stand the smell. Regarding fertilization, we have always used as little as possible because we have sandy soil and we want to care for it. However it was also (and especially) for the plant. Too much nitrogen inputs affect the taste and quality of vegetables. So since my childhood, we've always given to the plant just enough, not more! But regarding food, diversity and especially taste however we have always wanted to ´give more´. This has been and remains a high priority.

GUARANTEED ORGANIC

The Bolster is Demeter certified. Skal is the Dutch organization for organic certification, which controls and inspects our production. About the certification requirements, details are available on the following websites: www.demeter-bd.nl www.skal.nl. Some of our products are only labeled EKO. In this case, the seed propagation has been done for us on another organic farm (EKO but not Demeter). Obviously all our seeds are guaranteed non-GMO.

About the breeding activity

BOB AND THE DEVELOPMENT OF NEW VARIETIES

BOB is the Bolster Organic Breeding Team, installed since September 2010, passionately working towards the creation of those varieties we consider the most suitable for current organic (and low-input) farming conditions! We develop in our breeding programs open pollinated varieties, family-intercross varieties and hybrid varieties. The parent material for the breeding programs can be any of the before mentioned variety types. The last few years new varieties of broad bean (“Eleonora”), rocket (“Esmée”) and pumpkin (“Solor” and “Fictor”) were developed. Currently, the focus is on pumpkin, zucchini and tomatoes. Below, we would like to give you some information about family inter-crossing, heterosis and hybrids. So you can form your own well-founded opinion.

“Eleonora”, broad bean

“Esmée”, Rocket

“Solor”, pumpkin type red Hokkaido

“Fictor”, pumpkin type red Hokkaido

Bolster breeding

(Written by Bart Vosselman, Loes Mertens, Bertille Gieu Arbaret and Sara Preisel)

HETEROSIS AND A CASE OF TOMATO

Heterosis

Heterosis is another name for “hybrid vigor”. It has several definitions, but the most commonly accepted is the following: “a biological phenomenon in which F1 population obtained by crossing of two genetically dissimilar gametes or individuals shows increased or decreased vigor over better parent or over mid-parental value” (Rai N. and Rai M., 2006. Heterosis Breeding in Vegetable Crop. New india Publishing agency).The term heterosis is actually mainly used when the hybrid is superior to both the parents. Heterosis occurs widely naturally in both plant and animal species. It has been observed that it happens more often in cross-pollinators than in self-pollinators. The heterosis effect is genetically governed but it cannot be fixed from one generation to another generation, that is why it decreases in the F2 and later segregating generations. Important to note is that heterosis does not always occur when two genetically dissimilar individuals are crossed. It is thus not assured and that is why breeders have to make many test-crosses to find the best parental combinations.

The “magic” and drawback of heterosis: the case of a Bolster tomato variety

The expression of heterosis depends mainly on specific combining ability of a cross. It is actually the job of the breeder to find these “interesting crosses”.

The breeders have to find parental lines with complementary characteristics and by crossing them, the quality of hybrids in terms of taste, shape, color, morphology (ranking, length of the thrush, etc.) can be improved. To make it clearer, a successful example of crossing between two parental lines from the bolster organic breeding programs, is given in the following part.

Figure 1: *Pictures of tomato parental lines and F1-hybrid*

a/ Line 1, it has too much flowers and flowers too late.

b/ Line 2, inadequate organization of branches and fruit setting too late.

c/ F1-hybrid, good fruit setting, multiple long thrushes

In this example, both parental lines have several interesting characteristic but also a few negative ones (see Table 1 and Figure 1) that make them unfit to be sold as an Open Pollinated (OP) variety. However, the F1-hybrid shows excellent results and will be marketed in the coming years. A good F1-hybrid variety can be used to develop an OP variety. But in this case, 7 to 8 generations of self-fertilization are necessary to obtain sufficient uniformity. Indeed, as it has been mentioned heterosis cannot be fixed from generation to generation so it is not sure that all the positive traits will be found back in one plant - the chances to have them all together, are low.

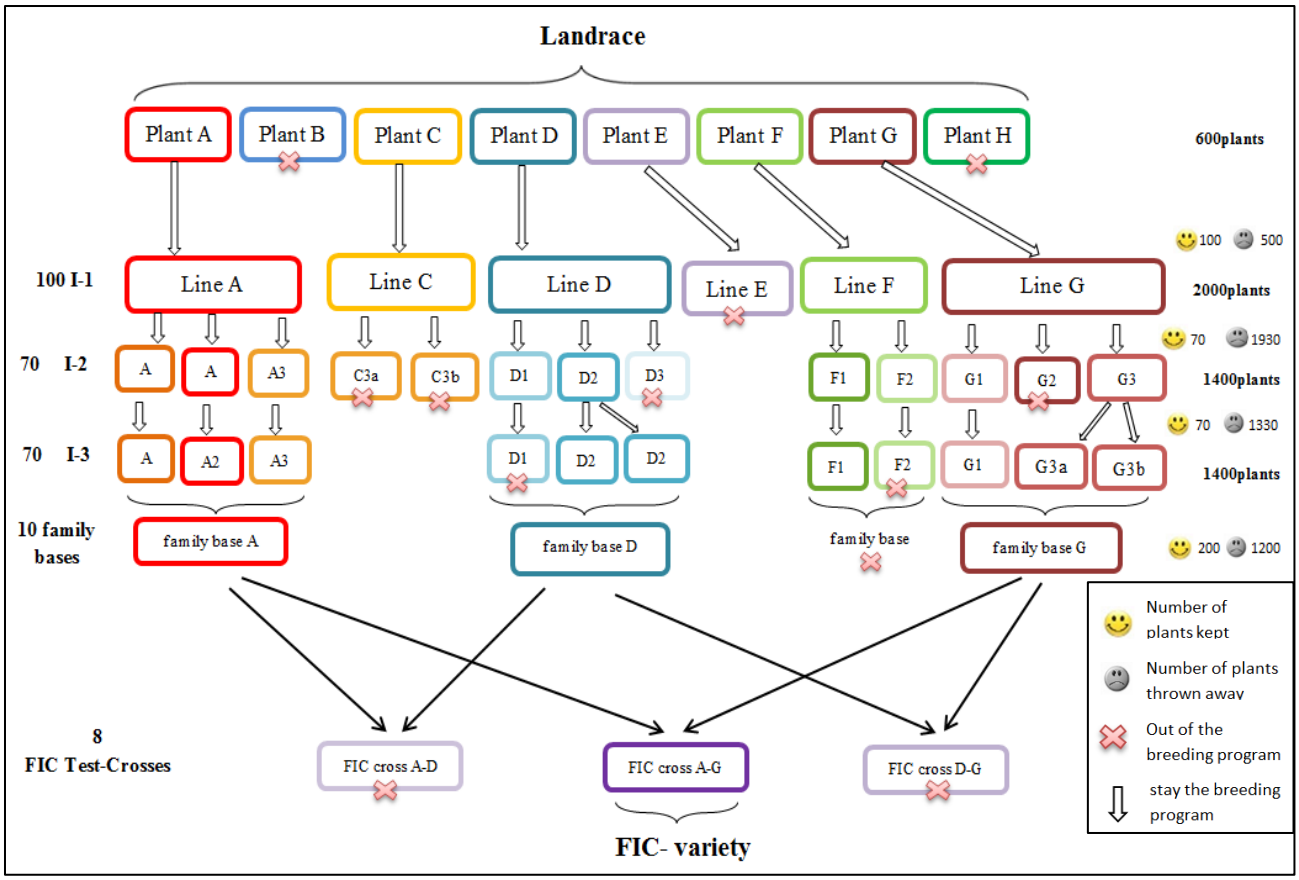
Traits/Line	Line 1 (Figure 3a)	Line 2 (Figure 3b)	Line1 x Line2 (F1-hybrid) (Figure 3c)
Flowering time	late	early	quite early
Cracking	not	Problematic in autumn	not
Fruit setting	insufficient	good	very good
Fruit size	10g	20g	18g
Bite	good	too soft	good
Nber of flowers	too much	enough	good
Thrush	too long	Splitting, not well organized	Long, multiple branched thrush
Taste	sweet	acidic	quite sweet
Cladosporium (Fulvia fulvum)	susceptible	resistant	resistant
Mildew (Bremia)	problematic	no	no

Table 1 *Characteristics of parental lines and test-hybrid*

FIC- VARIETY AND CASE OF PUMPKINS

In 2008, Mr. Vosselman from the Bolster organic seed company, developed a new breeding concept : the FIC Family Inter-crossing. It results from crossing between two partly-related base families. Both families are a mixture of inbred lines. They originate from two different plants from the same genetic source (in the case of the pumpkin: an orange landrace).

The following scheme is explaining how it has been developed.



	OP varieties	FIC-variety	F1: hybrids
Homogeneity	<95%	<95%	>98%
Heterosis effect	not present	important	really important
Development of new varieties (years)	8-10	4-6	6-8
fixation of intermediate inherited traits	no	yes	yes
Remarks	Less labor-intensive	knowledge and labor-intensive	technology and labor intensive

Table of comparison of OP, FIC and F1-hybrid

SUITABILITY OF HYBRID FOR ORGANIC AGRICULTURE written by Sara Preisel

Hybrids only for high-input?

Many conventional hybrid varieties are selected for high-input agriculture, but the generally better performance (in terms of yields, robustness and quality) is due to the heterosis effect which works as well in low-input production. Also hybrid varieties are best adapted to the conditions under which they are selected by the breeder. Most hybrids currently on the market have been selected for high-input (intensive) agriculture. Therefore the word has a connotation linked to intensive agriculture which it does not necessarily deserve.

Seed saving possible?

In most of the cases, when hybrid seeds are saved, the next generation (F2) will be fertile but give very diverse offspring, because homogeneity is not maintained and the parent genes are randomly mixed in the second generation. Some undesirable genes from the parent lines may be expressed. Therefore, hybrids are usually not used for saving own seeds.

Conclusively

Hybrids are commonly perceived as extremely uniform high-input varieties and because they cannot be propagated, their suitability for organic agriculture is sometimes doubted. Furthermore, the hybridization methods are sometimes seen as generally unnatural. However, hybrids are not generally more uniform, input-intensive or unnaturally propagated compared to modern open pollinated varieties. At de bolster, we are convinced that “good” hybrid varieties cán be suitable for organic agriculture, because hybridization can create high-quality robust and high-yielding plants that perform well under organic management. However, this requires selection under organic conditions and for differents traits. The Bolster organic breeding team (BOB) is currently working on the development of hybrid tomato-, zucchini- and pumpkin varieties.

Are hybrid varieties ‘high-input varieties’?

Hybrid varieties are often connoted with “high response seeds” requiring high fertility and chemical plant protection to achieve their high yields. Indeed, hybrids mostly yield more and higher quality and are more uniform than open pollinated varieties, which balances the higher seed price. The better performance is mainly due to their genetics. Whether a variety requires certain inputs depends on the conditions under which it is selected, and not the breeding method per se. For instance, a modern tomato variety, no matter whether open pollinated or hybrid, would be selected in a heated glasshouse, grown in stone wool with synthetic fertilizers. Neither of them will be really adapted to organic growing conditions. For this reason at de Bolster, tomatoes are bred in a non-heated glasshouse, in full soil, with organic manures and at less than a tenth of the common fertilizer levels. A hybrid selected under such conditions will be more adapted to organic production than a conventional open pollinated variety. Furthermore, disease resistances can more easily be introduced into hybrids, e.g. by combining two resistances from both parent linesTherefore, most professional producers, both organic and conventional, prefer to use hybrid varieties.. In short, , when they are selected under the proper conditions and with a focus on the right breeding goals, hybrid varieties can be very well adapted to organic growing conditions.

Are hybrid varieties less genetically diverse and therefore less robust?

The most important ways to increase genetic diversity in agriculture is by cultivating a high number of different crops and different varieties per crop. The diversity within a variety helps the variety to withstand diseases and other stresses. Hybrid varieties are indeed more homogenous than open pollinated population varieties, but about as homogenous as open pollinated line varieties. The reason is the legislation and market requirements, which require uniformity tests for each new variety to be registered. For example, in tomatoes (a self-pollinator), 99% homogeneity of both open pollinated and hybrid varieties are required to register a variety, in cabbage (a cross-pollinator), open pollinated varieties may be somewhat more heterogeneous than the hybrid. 99% homogeneity means that not more than 1 out of 100 plants may divert from the others. However, in hybrids each plant has a more diverse genome compared to inbred open pollinated varieties, because they contain two sets of different genes within a plant which also makes them more robust.

Hybrid varieties can also combine interesting traits that actually increase robustness of varieties, such as disease resistance, or cold or drought resistance.

Do hybrid seeds create a dependence on seed companies?

Most of the hybrid varieties are not sterile, but due to their diverse genome, the offspring will not have the same qualities as the hybrid but mix the properties of the parent lines randomly. In some cases, the parent lines may contain negative traits that are not expressed in the hybrid because the genes from the other parent balance them. These negative properties will reoccur in the offspring. Therefore, hybrid varieties are not suitable when one wants to obtain uniform and stable seed from own plants. As such, the production cycle cannot be closed completely on a farm, which might be seen as in contrast with the aim of organic agriculture.

Planting own saved seed of cereals, some legumes, fodder plants and potatoes is allowed, but the farmer has to report the planted amounts and pay a fee of 50% of the premium price for certified seed to the breeder. Saving seeds of these crops, especially fodder crops, is rather common in Germany and France (50% of the crop and more), but for example uncommon in Denmark (10% of the crop). However, many farmers (especially in developed countries) cannot afford to have the seeds cleaned (e.g. from weed seeds) and properly stored and are not willing to risk seed-borne diseases. Especially for vegetables, seed production is very complex as many vegetables take long to flower (e.g. onions, cabbages are bi-annual), they produce very small seeds (e.g. lettuce), the plants meant for seed production can often not be harvested, and one has to keep different varieties isolated so they do not cross-pollinate. Furthermore, especially vegetable producers have usually a large diversity of crops and varieties. Therefore, seed saving for vegetable crops is today so minimal that it is hardly even controlled although it is forbidden by law in most countries. Even in developing countries, vegetable seed is hardly maintained by farmers and often even imported, since many biannual plants such as cabbages, onions and carrots cannot produce seed under tropical conditions.

Opm: about prices? We already mentioned it in the main text, but that hybrids are more expensives but the return allows it..

The opinions about how far to go with respect to closing production cycles differ. Not growing hybrids alone will not close the production cycles. under today's legal situation . And the economic need for specialization is a complicating factor. Especially in the case of vegetable varieties, professional seed companies play an important in role in supplying high-quality, healthy seed of a diversity of varieties and crops that are especially difficult to multiply .

Does hybrid breeding violate the integrity of a plant?

In general, hybridization does not differ from the natural reproduction methods of a plant. As any breeding program, it involves self-pollination and cross-pollination, and either of the two can involve hand pollination. Laboratory techniques are not more necessary in hybrid breeding than open pollinated breeding. Self-pollination also occurs in most cross-pollinating crops in nature, and the other way around. For cross-pollinators, continued inbreeding indeed differs from the nature of the plant, but this is applied in part of the breeding programs for both hybrid and most open pollinated breeding. Since the inbred lines suffer from inbreeding depression, they are often weak and, in conventional breeding, highly protected with chemical pesticides. This was especially problematic in the beginning of hybrid breeding, but has improved today, though still being a problem. The robustness of the plant is restored by the final cross such that the hybrid itself does not suffer from the previous inbreeding. The weakness of the inbred parent lines leads some bio-dynamic researchers to find hybrids inferior in terms of 'etheric formative forces' and 'vital qualities'.

There are exceptions of very few crops, especially chicory and cabbage crops, where hybridization often involves protoplast fusion, a biotechnological method that goes beyond the possibilities of nature. To make sure every single hybrid seed results of a cross-pollination and not of an accidental self-pollination, hybrid breeders prefer to use male-sterile mother lines (with infertile pollen) which do not need to be castrated by hand. In many crops, for instance in maize, onions, rice or rye, male-sterility occurs naturally, but in cabbages and chicory it has been introduced through protoplast fusion. Thus, cabbage and chicory hybrids produced using protoplast fusion to introduce cytoplasmatic male sterility (CMS), can be regarded as violating the integrity of the plant. The organic sector aims to reduce the use of varieties created by this method, and therefore invests in CMS-free organic breeding especially of cabbages.

Summary

Hybrid varieties

- concerns only few crops (mainly cross-pollinators and few but broadly used self-pollinators crop)
- perform in general better than open pollinated varieties of the same crops (in terms of resistances, and quality)
- can be even more robust if bred under the right conditions
- only in the case of chicory and cabbage varieties use techniques going beyond the possibilities of nature
- are not appropriate when one wants to produce own seeds.

Both modern OP and hybrid varieties

- are genetically highly uniform due to the variety legislation.
- are not propagated by professional farmers in Europe.
- use inbreeding
- are often bred under and for high-input conditions.