3. What is the purpose of organic breeding?

The purpose of plant breeding for organic farming is to produce robust varieties that suit organic farming methods and that at the same time boost biodiversity. Organic plant breeding is a multi-facetted approach based on both the ecological and the ethical principles of organic farming that guarantees respect for the integrity of living organisms and therefore also for plants. See Section 5 for further information about the values of organic farming in relation to breeding. Breeders use specific techniques to achieve the following variety characteristics in organic plant breeding, see Table 1.

Table 1. Overview of desired variety characteristics and suitable breeding techniques

Ecological conditions	**Suitable variety characteristics**
• Adapted to less and slow-release organic fertiliser	• Nutrient efficiency (getting more from less, or being able to do more with less) • Early growth vigour • Deeper roots
• Good weed suppression	• Fast soil cover with leaves • Early growth vigour • Longer straw or wider leaves (such as in the case of cereals) for more soil cover or shading
• Robust varieties with less susceptibility to diseases and pests	• Resistance to diseases or field tolerances • Use of genetic variation in the field (for example through the use of variety blends) • Use of plant characteristics such as thicker wax layer on the leaf to protect against insects (for example thrips in the case of cabbage) or early harvestability to avoid disease or pests
Ethical conditions	**Suitable breeding techniques and work methods**
• Breeding techniques that respect the integrity of the plant	• For example: crossing and selection where the whole plant or crop in the field or in the greenhouse is involved • Sometimes DNA markers (as diagnostic aids) help breeders in the selection of these plants from the offspring that have specific characteristics, such as disease resistance
• Free access to varieties	• Breeders' rights provide sufficient protection and permit fellow breeders to use each other's varieties for further breeding without seeking permission

Breeding for simple characteristics

There are characteristics that are very simply inherited, such as some disease resistances that are based on one gene (monogenic). These can be relatively easy incrossed from wild relatives, see Figure 1 selecting for late blight resistance. A risk with these single genes and absolute characteristics is that they can be easily overcome by a mutation of the pathogen that is trying to survive. So breeders also seek more durable forms of resistance that are based on several genes and cannot be easily overcome. The disadvantage is that this does not always provide full resistance.

Figure 1. The selection process in the progenies of a crossing for late blight resistant potatoes. The selected plants are marked with a stick (Photo: Louis Bolk Instituut, Bioimpuls-project, www.louisbolk.nl/bioimpuls)

Breeding for complex characteristics

But there are also very complex characteristics, such as nutrient efficiency, rooting, drought resistance or salt tolerance. A lot of genes are involved in this type of characteristic. Moreover, plants are able to switch on various adjustment mechanisms in various conditions (cold or hot, dry or wet weather). The improvement of varieties for this kind of complex characteristic is therefore not simple and requires a lot more research.