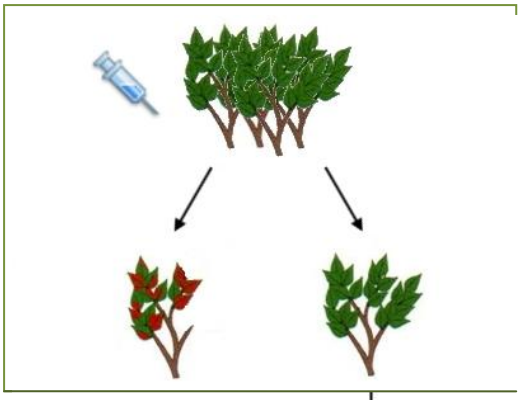
Agro-infiltration *'sensu stricto'*: accelerating innovation

For many years, plant breeding has been a trial and error exercise, whereby new varieties are produced from a cross between parental plants or through self-pollination. The process is based on identifying a desired characteristic in one plant - for instance higher resistance to a specific disease - and crossing it with another plant which allows the desired trait to appear in the offspring. However, a series of unwanted characteristics is transferred as well, which requires several more breeding cycles in order to be replaced by desired traits. This form of breeding takes many years to accomplish, which represents a very long time span given the need to rapidly address issues linked to climate change and food security. In order to speed up the process and allow for more precision and efficiency, new methods are needed. Several New Breeding Techniques (NBTs) have already been developed, among which Agro-infiltration *'sensu stricto'*.

Increasing availability of natural resistance genes

Until recently, plant breeding has produced plant varieties with new disease resistances through thorough screening of gene pools using classical disease testing in the open field or greenhouses. However, some plant diseases cannot be transmitted to host plants by mechanical inoculation but require an insect as a vector. This poses a serious obstacle to study the level of disease resistance of plant varieties. A New Breeding Technique that has been developed to overcome this obstacle is Agro-infiltration *'sensu stricto'*, which has become an established technology in the field of plant breeding.

Basically, plant parts (e.g. leafs) are brought in contact with cells of the bacterium *Agrobacterium tumefaciens* (in a contained environment, e.g. a greenhouse) which has the capability to transfer and integrate a part of its own DNA into the genome of the plant. This natural capability has been exploited to transfer viral genetic material to a plant cell (see Figure 1, opposite). This transfer effectively mimics a viral infection required to identify plants carrying a viral resistance gene. Resistant plants identified through Agro-infiltration *'sensu stricto'* can be used to produce progeny which is used to develop commercial varieties. Agro-infiltration *'sensu stricto'* is applied very locally on a plant; as a rule, the genetic material is not stably incorporated in the germline and therefore not transmitted to progeny. Plants derived from lines in the absence of a stably integrated event should thus be considered out of the scope of the GM legislation.



Infiltration (syringe) of parental plant with GM *Agrobacterium* (contained use)

Selection based on viral resistance in plants (contained use)

Resulting non-transgenic, resistant plant used for further breeding

Figure 1. Schematic representation of Agro-infiltration 'sensu stricto'. *A syringe is used to apply* Agrobacterium tumefaciens *which contains viral genetic material to mimic a specific viral infection. Resistant variants can be selected after Agro-infiltration* 'sensu stricto'. *The infection is temporary as it is not stably incorporated in the germline and therefore not transmitted to progeny. Therefore, the resulting selected plants are non-transgenic and can be used for further breeding.*

Where could Agro-infiltration '*sensu stricto*' be applied?

Plant viruses are responsible for many important plant diseases all around the world. Breeding for natural resistance to plant viruses is a major goal for plant breeding companies. While most resistance tests are easy, some plant viruses cannot be transmitted to host plants by mechanical inoculation. They require an insect as vector, a feature that has heretofore presented a serious obstacle to the selection of resistant plants in plant breeding programs. Utilising insects as vector organisms does not only pose practical problems, it also entails additional biosafety aspects when combining plants, viruses and vector organisms. Agro-infiltration '*sensu stricto*' is proposed as an attractive alternative method for controlled and specific introduction of a plant virus into (parts of) a plant without using an insect vector.

Figure 2. Tomato yellow leaf curl virus, transmitted by white fly; a susceptible (left) and resistant tomato leaf (right)

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Factsheet Agro-infiltration *'sensu stricto'* (drafted 2013)

Benefits

Disease resistance in plants is essential in practice since it provides protection of crops against pests and pathogens while reducing the need for spraying chemicals. Resistance therefore reduce costs for growers and farmers and are to the benefit of the environment; Agro-infiltration *'sensu stricto'* considerably increases the possibility to find these valuable natural resistances and resistance mechanisms.

Agro-infiltration '*sensu stricto*': added value for Europe's economy and innovative potential

Small and Medium sized Enterprises (SMEs), which represent a large part of the EU's innovative plant breeding sector, could especially benefit from Agro-infiltration '*sensu stricto*' to answer market demands and develop new varieties that are more sustainable or produce higher yields in a whole range of crops, including fruit and vegetable crops. Before this can happen however, EU Member States must align their position toward Agro-infiltration '*sensu stricto*'. If they can build on the notion that the technique creates exact the same varieties to those obtained through conventional breeding, the European plant breeding sector will be freed from expensive regulatory burden and its competitiveness will be given a strong boost. Indeed, companies, and SMEs in particular, will be able to focus their resources on research and valorisation of innovation within Europe rather than having to do so in non-EU countries – an added value for the European agricultural sector and economy as a whole. It will also level the playing field and allow the EU to effectively compete with other markets where the technique could be applied.

About the NBT Platform

The NBT Platform is a coalition of SMEs, large industry and prominent academic research institutes, which strives to bring clarity to the European debate on NBTs. Its aim is to provide policy makers and stakeholders with clear and precise information on NBTs and to generate awareness about their potential benefits for the European economy and society as a whole.

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