Grafting on GM rootstock

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 grafting of non-GM scions on GM rootstocks.

Grafting

The technique of grafting consists of inserting a vegetative part of a plant (termed the scion), usually a shoot or a bud, onto another, root-bearing plant (termed the rootstock), as illustrated in Figure 1 below. Normal vascular flow (e.g. nutrient flow) is established between scion and rootstock if grafting is successful, allowing for the growth and development of the scion. The shoots of the rootstock are usually eliminated, so that all the aerial parts of the grafted plant bear the characteristics of the scion. Grafting is commonly used in horticulture, with fruit trees, vegetables and ornamental plants, for example to combine the quality of the harvested products of the scion with beneficial characteristics of the rootstock, such as resistance to soil-borne disease or more efficient nutrient uptake resulting in a higher yield. Grafting of a non-GM scion onto a GM-rootstock works in the same way, utilising the required and/or beneficial characteristics of a specifically selected GM rootstock.

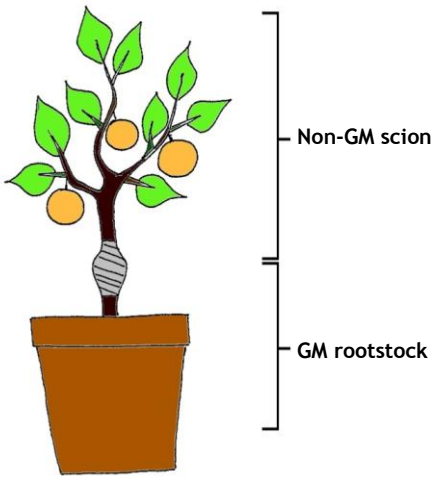

Figure 1. Simplified illustration of grafting. Here, a fruit bearing non-GM scion has been grafted onto a GM rootstock.

Image adapted from: http://ipts.jrc.ec.europa.eu/presentations/documents/15group4.pdf

Although the rootstock is regarded as GM, and will likely require cultivation approval, it has been established that heritable genetic material is not transmitted from the rootstock to the scion. Signalling molecules can be exchanged that affect the growth and development of the scion or rootstock, but these effects are transient in nature and not heritable. Therefore, any materials harvested from the non-GM scion are regarded as non-GM.

Benefits
Grafting can genetically improve rootstocks regarding soil borne diseases and pests. This can prevent treatment with chemical soil disinfectants or steaming of soil that would require a lot of energy. Grafting can also be used to improve the fruit quality of the non-GM scion.

Where could grafting on GM rootstock be applied?

GM techniques could be used to confer beneficial characteristics to the rootstock, as mentioned above. For example, GM rootstocks could be used in the future to improve resistance of fruit or forest trees to often devastating nematodes. GM rootstocks could also affect the development of the canopy in a desirable manner (e.g. earlier flowering, dwarfism). Alternatively, GM technology could also be used to create rootstocks with better water use efficiency thereby limiting the plant's need for water.

Figure 2. Increasing yield of tomato plants with grafting. Higher yield plant (right) is grafted onto a GM-rootstock, while the lower yield plant (left) is grown on its own rootstock.

Grafting on GM rootstock: added value for Europe's economy and innovative potential

Small and Medium Enterprises (SMEs), which represent a large part of the EU's innovative plant breeding sector, could especially benefit from grafting on GM rootstocks 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 grafting on GM rootstock. In January 2012, the EU Expert Working Group on New Breeding Techniques published a report outlining that grafting on GM rootstock creates products similar to those obtained through conventional breeding techniques or via normal biological reproduction methods, as long as the scion is from a non-GM plant. If the EU can build further on this conclusion, 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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