genetically uniform, and a better product. Already, we can see that the micropropagated plants are much better than those produced by the old system. This have given us confidence that we made the right decision in 1986.

Possibilities and Disadvantages of Genetic Variation

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INTRODUCTION

Plants grow by division of cells in the meristems. Normally the new cells are exact copies of the original cell, so every shoot on a plant has the same (genetic) characteristics. This also holds if the shoot is used as a cutting or in micropropagation because the vegetatively propagated plants are genetically part of the same plant.

However, mistakes may occur during cell division and so cells with new genetic characteristics appear. This is called mutation and is the basis of occurrence of off-types with characteristics other than those of the original plant.

MUTATIONS

The advantage of mutations is that usually only one characteristic changes at a time. If it is good (e.g. compact growth, a new flower colour), the off-type can be used directly as a new cultivar without a need for further breeding. The disadvantage is that new characteristics are usually bad (e.g. slower growth), and thus only show up as loss of uniformity. Problems with genetic variation can be prevented by using only the best plants as stock plants and renewing the stock plants when a certain number of plantlets have been produced. This will happen sooner when using micropropagation; however, by using good tissue culture techniques the number of genetic off-types can be kept as low as for cuttings.

The risk of mutations is not constant, it is known that it can be raised by using irradiation or certain chemicals. The risk of off-types also differs greatly among species and cultivars. Chimeras, plants that have genetic differences between cell layers within the same plant, have a particularly high risk of off-types. Many cultivars with variegated leaves or marbled bracts are chimeras. Such plants are unstable when propagated—both as cuttings and in tissue culture.

MICROPROPAGATION

It is a problem in micropropagation that some kinds of off-types, such as changes in flower colour, are difficult to detect during propagation. Certain tissue culture techniques, such as callus culture and adventitious shoot formation, increase the risk of variation; however, this can be exploited as an advantage in mutation breeding. In addition, one must also be aware that the hormones used in

micropropagation can induce other types of aberrant growth, such as fasciation (brooming) and vitrification (glassy leaves). Although these aberrations are not genetic variation, for growers such aberrations are often worse than mutations because a majority of the plants in a lot may be affected.

By using high concentrations of hormones higher growth rates can be achieved in tissue culture, giving cheaper plants but also a greater risk of both genetic and temporary aberrations. Because of this it is important that the laboratories use strict quality control procedures and consider the risk of unwanted variation when choosing varieties and propagation techniques. Growers can reduce the risk of unpleasant surprises by using only plants from laboratories with a good reputation and by reporting quality problems to the laboratory.

Only few documented examples exist of serious problems due to genetic variation after micropropagation, but the micropropagation is often blamed when no other explanation for bad results is known. If a bad plant "grows out of it" the problem has not been genetic.