

# Protoplast fusion and organic farming

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## **Introduction**

Protoplast fusion is a breeding technique under the (EC and IFOAM) definition of genetic engineering. Therefore it must not be used in organic plant breeding and seed originated from it should not be allowed in organic farming. Many organic farmers and breeders agree on that and protoplast fusion is not indispensable for plant breeding. But in reality its products might be widely used by organic farmers. Therefore the question is how do we ban protoplast fusion from organic farming?

## **What is protoplast fusion?**

Protoplasts are isolated plant cells without a cell wall. They only have a cell membrane. Protoplast can be obtained by incubating pieces of, for example, leaf tissue until the cell walls dissolve. Chemical or electric stimulants are used to fuse protoplasts from different species, resulting in a tetraploid which is cultured using tissue culture techniques. The resulting plant has characteristics from both parents, though not all will be expressed. Protoplast fusion is basically hybridisation at the vegetative level (see appendix)

## **Why use protoplast fusion?**

Protoplast fusion is most commonly used to incorporate cytoplasmic male sterility (cms) in hybrid varieties. A well-known example of this is cms which occurs naturally in Japanese radish and is incorporated in cabbage. The advantage is the fact that cms simplifies the procedure of hybridisation and reduces the percentage of undesired inbred plants (deviants).

## **Natural cms**

In some species, for instance carrot and onion cms occurs naturally. In those cases the cms can be incorporated in new varieties of the same species by natural crossing. In organic plant breeding cms should only be used with so called "restorer genes". When cms hybrids are used without restorer genes, their offspring stays male sterile and the genes from a cms hybrid are not available for other breeders. (see appendix)

## **Ethical objections to the use of protoplast fusion**

\* the integrity of plants is violated

Protoplast fusion goes beyond the level of the organised cell, which is biologically seen the smallest living entity, and affects the cell coherence and organisation. The cell wall is dissolved and cells are separated from the living context of the plant or tissue.

\*the genetic integrity of plants is violated.

With protoplast fusion natural crossing barriers can be forced. This technique is mostly applied when two species differ so much that a successful crossing cannot be achieved under natural circumstances. (see appendix)

## **Other reasons to ban protoplast fusion**

Protoplast fusion is a genetic engineering technique. Since the ban of GM is a major topic for the organic sector; we should make an effort to realise a legal ban on protoplast fusion. Otherwise we might lose our credibility on this point.

### **IFOAM Basic Standards**

The IFOAM Standards include the following definition of genetic engineering:

Genetic engineering is a set of techniques from molecular biology (such as recombinant DNA) by which the genetic material of plants, animals, micro-organisms, cells and other biological units are altered in ways or with results that could not be obtained by methods of natural mating and reproduction or natural recombination.

Techniques of genetic modification include, but are not limited to: recombination DNA, *cell fusion*\*, micro and macro injection, encapsulation, gene deletion and doubling. Genetically engineered organisms do not include organisms resulting from techniques such as conjugation, transduction and natural hybridisation.

\* *protoplast fusion is a kind of cell fusion*

### **IFOAM Draft Standards**

The IFOAM Draft Standards include a section on *Plant Breeding and Multiplication Draft Standards*. This section contains a list of plant breeding methods that are 'suitable and permitted for organic plant breeding'. This list excludes cell fusion.

### **EU legislation**

According to the Regulation on Organic farming (EEG nr. 2092/91) it is forbidden to use genetically modified organisms and/or products derived there off.

For the definition of a genetically modified organism (GMO) and techniques of genetic modification (resulting in a GMO) the Regulation refers to Directive 90/220 which now has been replaced by Directive 2001/18.

According to EC Directive 2001/18 there is a difference between certain kinds of protoplast fusion and other genetic modification techniques like micro-injection.

Cell fusion (including protoplast fusion) and hybridisation techniques are only included in the Directive where "live cells with new combinations of heritable genetic material are formed through the fusion of two or more cells by means of methods that do not occur naturally".

Cell fusion is excluded when it is a fusion "of plant cells of organisms which can exchange genetic material through traditional breeding methods".

In practice the EC uses a very broad interpretation of this exception. Fusion of plant cells of organisms within the same family is not considered a technique of genetic modification under the Directive. Even when those species, for instance radish and cabbage, cannot "exchange genetic material through traditional breeding methods".

This means you don't need a license to use this technique and the seeds originated from it are not labelled as 'GM'. As a consequence of that seeds made with the use of protoplast fusion are not recognizable (for farmers) as being GM. Therefore it is hard to implement a ban.

It is unclear if the exception for protoplast fusion in the Directive also automatically applies for the regulation on organic farming. If so, certain kinds of protoplast fusion would be legally allowed in organic farming. Our representative from the ministry of agriculture in the SCOF is trying to get an answer to this question.

### **How to recognize seeds made with protoplast fusion**

Until now organic plant breeders don't use protoplast fusion and also the organic seed producers know how to recognise and avoid varieties made with this technique because they know that the discussion is ongoing. Often those seeds are patented and labelled as CMS or 'super' hybrids. But organic farmers who buy conventional seed can use those seeds without knowing they are in fact made by genetic engineering.

### **Consequences of a ban**

At variety level: a few modern cabbage, endive, leek and chicory varieties would be ruled out for organic agriculture.

At breeding level: protoplast fusion is not of great importance yet. Goals of organic plant breeding can be achieved without it. As an alternative, a hybrid breeding program for cabbage could also be based on self-incompatibility (hinders self-fertilisation) of some cabbage species. But then a certain percentage of undesired inbred plants (deviants) must be accepted by the farmers.

### **Relevant questions**

- 1) Do we (all) want to ban protoplast fusion from organic farming?
- 2) How widely is it used, in organic agriculture (by breeders, propagators and farmers)?  
How is the situation in different European member states?  
How is the situation outside Europe?
- 3) How far do we want to go with our ban; How are we going back in the breeding chain to check whether protoplast fusion is used?

We could implement a ban on the use of protoplast fusion

- for organic plant breeders
- for organic seed propagators (seed producers)
- for organic farmers who use conventional seed.

- 4) How can we implement a ban?
  - Legally
  - Inform the farmers
  - Make a (black) list of varieties made by protoplast fusion

### **Reference:**

Alfoldi, Th., Plant Breeding techniques - An evaluation for organic Plant Breeding, FiBl Dossier no 2, sept. 2001. FiBL, Frick-CH.

Lammerts van Bueren E., M.Hulscher, M.Haring, J.Jongerden, JD van Mansvelt, A.P.M.den Nijs, G.T.P.Ruivenkamp, 1999. Sustainable organic plant breeding - a vision, choices, consequences and steps. Louis Bolk Instituut, Driebergen, 60 pp.

Lammerts van Bueren, E.T., P.C. Struik, M. Tiemens-Hulscher & E. Jacobsen, 2003. The concepts of intrinsic value and integrity of plants in organic plant breeding and propagation. Crop Science 43: 1922-1929.