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Articles in this issue

Pollen dispersal of genetically modified oilseed rape to organic fields:

Analysis of available data and the possibilities for co-existence

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Results from model estimations based on existing data on gene dispersal in oilseed rape indicate that the GM dispersal by pollen to organic fields primarily can be limited by the use of isolation distances. The results also indicate that because of pollen dilution, large fields are better protected from GM pollen dispersal than smaller fields. For large fields (i.e. field width > 200 m), the risk of dispersal from GM fields by pollen will be limited (approx. 0.1%) at distances above 100 m. For small fields (i.e. width = 50 m), some GM pollen dispersal (up to approx. 0.3%) may be expected even with an isolation distance of 200 m. If the fields are very close, the use of additional protective buffer zones may be required.

The problems concerning co-existence of genetically modified crops and organic or conventional non-GM farming are now brought much into focus both in Denmark and elsewhere in Europe (see e.g. BioSociety 2003). The existing moratorium on commercial cultivation of new GM plants is expected to be abolished in October 2003, when the EU adopts regulations on labelling and traceability. At the same time, **22 new GM plants** (e.g., mays, oilseed rape, fodder- and sugar beet, cotton, potato and soya) are being applied for marketing in the EU. Already, a number of GM crop plants have been approved for marketing in the EU. The majority of the new GM crops are suited for cultivation in southern or middle Europe, only a minority in Northern Europe.

A **report on the issues of co-existence** from the Danish Ministry of Food, Agriculture and Fisheries was published in August 2003. In the report, oilseed rape was identified as one of the major crops, which will be most difficult to protect from contamination of GMO in the future.

In a **research project** under DARCOF II, scientists from NERI are presently studying how much GM dispersal of pollen to organic fields, which can be expected under different conditions (the extent of GM farming, distribution of GM and organic fields in the landscape, field sizes, etc.) and how this GM dispersal may best be controlled.

By computer modelling, NERI has made a so-called meta-analysis in order to summarise the results from a number of field trials with oilseed rape in e. g. England, France, Australia, Canada, USA, Denmark and Sweden. In many of these trials, herbicide resistance was used as a genetic marker and the results from these trials have been used to predict the similar gene dispersal from a GM field to an organic field of oilseed rape. The results are presently submitted for publication, but some preliminary results and

conclusions are presented here.

The majority of oilseed rape pollen is dispersed only a short distance from the mother plant and the probability of dispersal normally decreases rapidly with distance. However, pollen of oilseed rape may disperse by wind or insects for several kilometres, but is diluted by the pollen produced in the receiving field. The main questions, which were studied by modelling, are how the distance between fields affects gene dispersal and the effect of the field size on the total GM dispersal and the percentage of seeds containing GM.

Results from the modelling (**Figure 1**) show as expected that the GM-content of the seeds from an organic field will be reduced with increasing distance to the GM field. This is particularly evident for small fields. Furthermore, the results indicate, that an increase of the size of the organic field (field width) has a relatively larger effect in reduction of the average GM-content than increasing the isolation distance. This effect is mainly caused by a dilution of the GM pollen by pollen from the receiving field. Other results from the study indicate that the use of a protective buffer zone (i. e., 5 m border, which is excluded from the harvest) will reduce the GM contents by approximately one third. Consequently, if the fields for some reasons cannot be separated by distance, then the use of a buffer zone may be a possible solution.

The results indicate that a critical level of 0.1% GM content in the organic crop of oilseed rape can be obtained by an isolation distance above 100 m if the field is at least 200 m wide (Figure 1). For small organic fields (width = 50 m), a low level of GM pollen dispersal (up to approx. 0.3) may be expected even with an isolation distance of 200 m.

There are a number of critical assumptions for the conclusions above, which must be mentioned. It is important to stress that the employed method of study and the consequent results has some scientific restrictions, which may result in a higher level of gene dispersal than indicated by the model results. Hence, the results are based on the assumption that the GM field and the organic field are relatively equal in size. If the GM field is significantly larger than the organic field or if several GM fields are situated in the surroundings of an organic field, the extent of the GM dispersal will increase. It is also well known that the dispersal of pollen into a field may be irregularly distributed, and small pockets with higher concentration of GM-content will arise.

The assumptions for the model include that varieties with normal fertility are used. If hybrid varieties with male-sterile plants are cultivated in the organic field, the probability of GM pollination will increase depending on the percentage of male sterile plants. Furthermore, pollen dispersal from hybrids between GM oilseed rape and weedy relatives or from GM-volunteers in the surroundings has not been included in the model simulations.

When the relevant management measures are taken to reduce GM pollen dispersal, we expect that an isolation distance of 100 m will result in a GM content in the range of 0.1 % to 0.3 % of the total oilseed crop in the organic field (very small fields excluded). Single test samples collected from especially the field margins may however show a higher GM content. A threshold value of 0.1 % is normally regarded as the lowest measure, which can be detected by field sampling and genetic analysis.

The present model results do not consider the topographic conditions or the different possible scenarios for the extent of GM cultivation in Denmark. Therefore, NERI is also constructing a model of atmospheric dispersion in order to predict the wind dispersal of pollen of oilseed rape and grasses in the landscape based on e.g., biological and meteorological data and the location of cultivated fields. The dispersion model may be used to predict conditions under which the risk of GM pollen dispersal is

particularly high (e.g., the number of GM fields in relation to the number of organic fields, particular wind situations and the topographic structure). Furthermore, the model could perhaps be used to select the fields where monitoring of GM dispersal are most urgently required.

The model results for oilseed rape will be presented at the **First European Conference on Co-existence of Genetically Modified Crops with Conventional and Organic Crops** the 13th to 14th November 2003 in Elsinore, Denmark.

References

Bio-Society, Research on-line (2003) Agriculture, sustainability: round-table looks for common ground on GM crop 'co-existence'.