ECONOMIC EFFECTS OF CO-EXISTENCE MEASURES IN MAIZE CROP AND SEED PRODUCTION – A CASE STUDY OF FRANCE

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Abstract

The paper analyses the economic effects of specific co-existence measures (like e. g. increasing isolation distances between GM and non-GM plants, changing flowering time between varieties, non-GM buffer zones) in maize crop and seed production in selected regions in France. The results are based on simulations of agronomic measures and corresponding cost calculations for specific measures and landscape simulations. In maize grain production levels of adventitious presence below 0.9% can be achieved without any co-operation between farmers in neighbouring clusters. In case fields are located in the same cluster, additional measures have to be taken with very differing cost effects depending on the specific characteristic of the measure. Additional measures should also be taken (either by the seed company or by the commercial GM grower) for ensuring co-existence between commercial GM fields and non-GM seed production clusters, while current practices would be sufficient for ensuring co-existence between GM and non-GM maize seed production plots for a threshold of 0.5% adventitious presence.

Introduction

Since April 2004, the EU system to trace and label GMOs and to label products derived from GMOs has been put in place. The regulations set a threshold no higher than 0.9% for the

[*] *The views expressed in this paper are those of the authors and do not necessarily correspond to those of their respective institutions.*

adventitious presence of GM material in non-GM products (Regulation (EC) 2003/1829). In July 2003 the European Commission (DG Agriculture) released Commission Recommendation 2003/556/EC on general co-existence guidelines and asked member states to set up national strategies and best practices to ensure the co-existence of GM crops with conventional and organic farming. In the specific case of seed production, the European Commission decided to regulate the adventitious presence of GM seeds in conventional seeds under Directive 2001/18/EC rather than in a specific directive on the marketing of seeds. Several studies analysed the possibilities of co-existence schemes and its economic effects on maize production in Europe (e. g. Bock et al. 2002, Tolstrup et al. 2003). However, a lot of questions could not be clarified in these studies in particular with respect to production of certified maize seeds. Therefore thresholds for the adventitious presence of GM seeds in conventional seeds are still under discussion in the EU. This paper contributes case study analyses on co-existence measures and its economic effects in GM maize crop and seed production in France.

Methodology

Based on agronomic considerations geographical areas have been identified in European Member States which were most likely to adopt GM maize. The sources of adventitious GM presence in conventional maize, the levels of admixture estimated with current and additional farming practices and the economic effects of adapting farming practices for maize crop and seed production in France were analysed within the project. Different levels of initial seed purity were considered in order to estimate their effect on the final level of adventitious presence using a model of gene flow namely MAPOD®. Simulations were carried out on landscapes representative of two French regions: the *département*[1] of "Pyrénées-Atlantiques" in south-west France for seed production and the "Poitou-Charentes" region in western France for crop production. Two scenarios were built for the presence of GMOs in the landscape (10% and 50% share of GMOs in the relevant crop), three agricultural production systems (GMO-based, conventional and organic) as well as different thresholds for adventitious GM presence: 0.1% and 0.9% for crop production and 0.1%, 0.3% and 0.5% for seed production. In a first step the economic performance of the different crops is investigated by reviewing literature, collecting publicly available statistical information and searching databases, as well as contacting and interviewing experts. The costs of co-existence measures for the different crops, farm types and regions as suggested as outcome of agronomic analyses are calculated in a second step using publicly available data sources of costs of agronomic practices. When calculating the costs of co-existence measures labour costs as well as opportunity costs of an alternative use have been taken into account. If necessary, available data are modified according to the situation in the defined farm type and region. In order to check these modifications additional experts have been consulted in rarely cases.

[1] French administrative district.

Measures

Simulations with MAPOD® were carried out to evaluate the impact of current practices as well as the feasibility of alternative practices. Different strategies were tested (figure 1):

Spatial isolation: Farmers in the region studied had to maintain an isolation distance between GM and non-GM crops. Increasing isolation distances is an effective way of decreasing adventitious presence by cross-pollination.

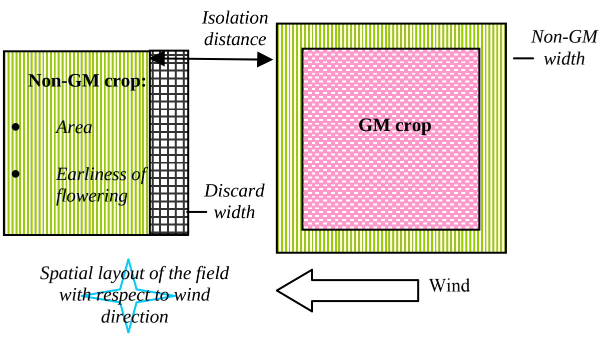
Time isolation: Separating flowering times is another option proposed to maize seed producers in France (GNIS[2], 2003). This can be achieved by providing a choice of varieties, some flowering earlier than others.

Non-GM buffer zone: Sowing an area of non-GM maize all around the GM field could be an interesting strategy for limiting or diluting gene flow from the GM field to the non-GM field. Farmers can consider this area as a refuge, limiting the development of resistance (e. g. in case of insect-resistant maize).

Discard width: The discard width of a non-GM field is an area of variable size around the edge of the field. The use of discard widths involves separately harvesting the margins and the central part of the field.

Plant extra male rows: Current legal isolation distances for certified seed production for France are 300 meter (seed cluster < 10 ha) respectively 200 meter (seed cluster ≥ 10 ha). In recent years, it has become possible to reduce isolation distances by planting extra male fertile rows around seed production plots. These extra male rows act as "protection" for female plants by making foreign pollen less competitive.

Figure 1: Illustration of different measures to avoid cross pollination in maize crop production



Preliminary results

Economic effects in maize crop production

France is the leading maize producer in Europe (EUR 15). The Poitou-Charentes region has been chosen for a case study for maize crop production since it represents the third largest grain maize producing region and accounts for about 11% of the area under maize in France.

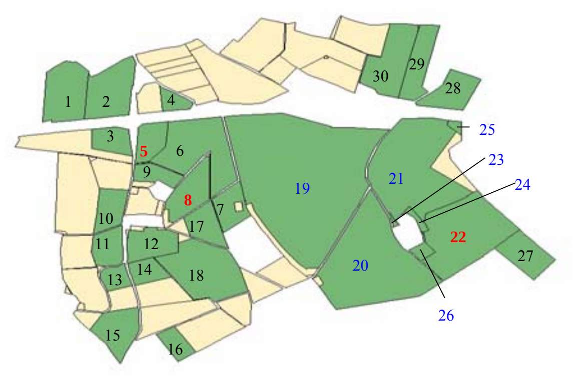
[2] GNIS: Groupement National Interprofessionnel des Semences (National interprofessional association for seeds and plants).

Furthermore, GM maize varieties are an alternative for farmers with problems controlling weeds and European or Mediterranean corn borer infestations. Variable production costs of 687 €/ha and an income of 950 €/ha form the baseline for the calculation of costs of co-existence measures in maize crop production in France resulting in a gross margin of 743 €/ha in the year 2004 if compensation payments were taken into consideration (Theyssier, 2004). Since the costs of several co-existence measures differ depending on the potential economic performance of the cultivated GM maize (for that no empirically sound data are available for France so far) it is assumed in a first case that GM maize has the same gross margin as non-GM maize, while an economic advantage of GM maize compared to non-GM varieties is considered in a second case.

There are very low opportunity costs of increasing isolation distances in maize crop production due to the small differences in the gross margins of alternative crops whereas the changing of flowering times causes substantial income losses for farmers active in maize crop production. The opportunity costs of discard widths on the non-GM field (which is separately harvested) significantly differ depending on the width of the discard width as well as the size of the non-GM field. High differences in the per-hectare costs can also be observed for non-GM buffer zones around GM fields mainly depending on the GM adoption rate in a region and the estimated economic performance of GM maize.

The economic effects of non-GM buffer zones were analyzed in a landscape with GM maize production (Figure 2). Based on the simulations of the level of adventitious presence of GM pollen in different fields, big variations can be observed in the additional costs of non-GM buffer zones, depending on the sizes of the GM fields, the width of the buffer zones as well as the underlying assumptions concerning the economic performance of GM maize in France. Significant cost savings can be achieved if the fields producing GM crops are clustered in the region, in particular if small-sized GM fields are concerned.

Figure 2: Example of field pattern used for the landscape scale study: 10 % GM maize adoption



Economic effects in maize seed production

Maize seed production in Europe covered 126,311 ha in 2003 with France being the leading seed producer in Europe (49,822 ha). In France 50% of seed production is concentrated in the south-west region and two "*départements*" (Landes and Pyrénées-Atlantiques) account for 25% of the national production[3]. To estimate the economic effects of the co-existence measures suggested, it was assumed that a yield of 3.5 t of maize seed per hectare generates a total income of €3 365/ha from maize seed production in France (Hugger, 2004). Taking into account variable production costs of €2 177/ha and additional compensation payments, a gross margin of €1 488/ha (representing the situation in 2003 and 2004) was taken as the baseline for the cost calculations for maize seed production (Hugger, 2004). The economic effects of increasing isolation distances were calculated for a kind of worst-case scenario in which the farmer producing GM maize seed has to reduce his seed producing area and plant the most economic crop (i.e. wheat) as an alternative. This results in very substantial gross margin losses in particular if additional isolation distances exceeding 150 m are concerned. Substantial opportunity costs also have to be added if 18 additional male rows have to be cultivated in order to reach a defined threshold of GM adventitious presence. Changing the flowering time of the seed maize varieties cultivated also has negative effects on yield which are quite substantial in the case of switching from very late to late varieties (30°days). The income losses are significantly lower if the flowering time is switched from late to mid-early varieties.

In a final step the economic effects are calculated for combinations of different measures in case that GM and non-GM seeds are produced in a region. The lowest per-hectare costs of such combinations of measures necessary to meet a defined threshold differ considerably, depending on the sizes of neighbouring non-GM seed production plots. In order to meet a threshold of 0.5% in maize seed production, substantial opportunity costs has to be assumed in the case of non-GM seed plots of 0.5 ha, while this threshold can be met without any additional costs in the case of 5 ha non-GM seed plots. The same picture emerges if a 0.3% threshold has to be met. The opportunity costs of additional measures to meet a 0.1% threshold add up to a substantial proportion of the gross margin even in the "best case" 5 ha non-GM seed plots.

Conclusions

The feasibility of co-existence between GM and non-GM grain maize production should be evaluated on a case-by-case basis. In case GM and non-GM fields are located in separate clusters, levels of adventitious presence below 0.9% can be achieved without any co-operation between farmers in neighbouring clusters, whatever the proportion of GM maize in the landscape, be it 10% or 50%. If GM and non-GM maize are to co-exist in the same field cluster, various additional measures (including isolation distances, non-GM buffer zones, time-lag, etc.) could make it possible to attain adventitious presence rates below 0.9%. Those strategies could imply co-operation between farmers in the same cluster (e.g. time-lag strategies). The additional costs of co-existence measures (e.g. non-GM buffer zones), when needed, vary substantially depending on the specific characteristics of the measure (e.g. width

[3] Source: Courtesy of GNIS.

of the buffer zone), the relative sizes of GM and non-GM fields, and differences in market prices of GM and non-GM maize. Consequently, the level of additional costs can only be estimated case by case.

Maize seed is already produced under contracts between seed companies and farmers and is organized by clusters of fields dedicated to seed production. .Ensuring co-existence between GM and non-GM maize seed production plots within a seed production cluster (seed-seed co-existence) should be relatively easy for a threshold of 0.5%, as current practices would be sufficient. For a 0.3% threshold, additional measures would have to be taken, either allocating GM and non-GM seed plots with the right orientation (with respect to wind direction) or increasing isolation distance. However, this measure could lead to significant gross margin losses for farmers and seed companies. Ensuring co-existence between commercial GM fields and non-GM seed production clusters (seed-crop co-existence) is a real issue. At least for some of the plots within clusters (the peripheral ones), additional measures should be taken, either by the seed company or by the commercial GM grower.

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