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GM agrofuels – more problems to come

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Abstract: A growing demand for fuel is likely to lead to the development of genetically modified (GM) crops that can be used as commodities for agrofuels. Market pressure could lead to an acceptance of lower regulatory standards for their risk assessment and conditions for cultivation. Contamination of food and feed crops with non-edible GM agrofuel crops can threaten food safety and food security. Simulations therefore must not only focus on percentages of GM contamination, but have to take other aspect of cultivating non-food/feed GM crops into account.
Keywords: agrofuels, GMO, contamination

Introduction

2007 saw an enthusiastic push in the political arena towards an increased use of agrofuels as a way to reduce carbon emissions from petrol and diesel fuel. Despite criticism by human rights and environmental NGOs, the EU decided that by 2020 10 % of all transport fuels would have to be agrofuels. At the beginning of 2008, problems became obvious, especially increased commodity prices due to the competition for the same crop as food, feed and fuel. In summer 2008, a report for the World Bank (Mitchell 2008) attributed even up to 75 % of the food price increases to the use of crops as agrofuels. In this situation, GM agrofuel crops are put forward as a solution.

However, agrofuels are neither a solution to climate change nor to increasing oil prices. Estimates show that using land for agrofuel production first of all leads to carbon debts, ranging from 17 years (sugar cane on scrubbery savannah), to 48 years (maize on set-aside agricultural land) to 840 years when oil palm plantations displace tropical rainforest (Fargione et al. 2008).

Plants used

For agrofuels (or biofuels) biomass energy is converted into liquid fuels in two different ways. Sugar and starch crops (sugar cane, sugar beet, maize) are fermented by yeasts to produce ethanol. The oils of (naturally) oil-producing crops, such as oilseed rape, soy, algae or jatropha are either burnt directly or chemically processed into biodiesel. For the development of 'second generation agrofuel crops' such as trees (poplar, eucalyptus) or switchgrass are genetically modified to contain higher cellulose and lower lignin levels for a more efficient ethanol production. In addition, GM cellulosic agrofuel enzymes are developed for a more efficient ethanol production. Changes in the plant composition and other modifications (mainly through genetic engineering, but also through conventional breeding) can lead to crops that are not suitable for consumption. Syngenta owns inedible sugar-cane varieties with ultra-high quantities of cellulose (Grain 2007a).

The development of GM crops that can grow on marginalized land are also often put forward as a solution. However, first experiences with the cultivation of jatropha point to a different scenario. Jatropha curcas is a bush with oily seeds that can grow on marginalized land, but its average yield increases up to tenfold when grown on fertile, irrigated land. Plans are under way for example by BP to establish large jatropha plantations in Indonesia (GRAIN 2007b).

Known problems of industrialized agriculture

With the exception of some local projects, agrofuel crops are produced in the existing agricultural system of large-scale, industrialized agriculture and plantations. Environmental problems are already known. The increase of oil palm plantations in Indonesia for example are the major factor for the extinction threat to orang-utans. The existing Dead Zone in the Gulf of Mexico, caused by agrochemical run-off of the fields around the Mississippi, is estimated increase beyond its present 20,000 km^2 if the US fulfils its goal to increase agrofuel production by 2022 (Donner & Kucharik 2008).

The large scale production of cash crops also goes hand in hand with social and human rights issues. Experiences from South East Asia or from Latin America show numerous examples of land evictions, destruction of rural/indigenous communities, conflicts about (access to) water, and environmental and health problems through massive spraying of agrochemicals. Especially experiences from Argentina where agricultural diversity has been replaced by large field of herbicide tolerant soy fumigated with glyphosate from low flying planes show the wide range of effects of a single GM crop with modified traits. Since it is very likely GM agrofuel crops will be grown in such an agricultural system, these issues have to be taken into account just as well as environmental effects.

While some countries, like e.g. the EU member states, have environmental standards and regulations for issues like usage of agrochemicals, isolation distances for GM crops or protected nature areas in agricultural landscapes, most agricultural producer countries miss similarly strict regulations, and it is unlikely that strict regulations can be introduced against the economic pressure to produce large quantities of agrofuels.

No basis for an appropriate risk assessment

For cultivation approvals in the EU, the environmental risk assessments (e.r.a.) are mainly based on the (often criticized) concepts of substantial equivalence or similarity.

These concepts that are based on an assumption that GM crops and conventional crops only differ in the intended change, for example in the production of an additional protein, and they have been criticized as not sufficient. However there is even less guidance about how to assess the risks of GMOs that are modified to such a degree that they cannot be considered "substantial equivalent." This is for example the case with trees (e.g. poplars) with changed lignin/celloluse ratio will make the cellulose more accessible for bioethanol production. Lignin is involved in major biological functions such as mechanical support, water conduction and pathogen defence (VBI 2007).

Political and economical pressure might lead to situations in which GMOs for agrofuel production are accepted without proper risk assessment as the lesser evil compared to transport fuel shortages.

Contamination by GM agrofuels

The biggest added risk of GM agrofuels probably lies in the contamination of food and feed crops by inedible agrofuel varieties. Currently existing crop varieties are used as agrofuel commodities, while on the other hand nearly all GM crops are at least meant for consumption as food and/or feed, even if different assessment exist about what is safe enough. Contamination with GM crops cannot be avoided, and contamination occurs through a number of different means ranging from pollen flow and volunteers, to contamination by farm machinery and transport. For 2007, the GM contamination register lists 39 new contamination events in 23 countries, since 1997 at least 216 events were reported from 57 countries (www.gmocontaminationregister.org).

Currently most genetic modifications of food/feed crops results in GM crops that are meant for further consumption, even if states differ on the issue of whether the conducted health risk assessments are sufficient and what kind of effects are causing a health problem or not. In this context, contamination is mainly discussed as an issue of labelling and as financial disadvantage.

Contamination with non-edible GM agrofuel crops however can have more far reaching contamination effects, resulting in threats to food safety and food security, especially for rural communities. Firstly, food becomes unsafe to eat when harvests are contaminated with non-edible crops. Secondly, contaminated seed can also result in the loss of seed supplies once contamination is detected. This threatens food security, the availability of food and one's access to it. Negative effects on food security will be higher in agricultural systems that rely on farm-saved seeds and in regions where little systems exists that could replace farmers contaminated supplies with non-contaminated seed. On the longer run, this could also lead to the loss of agrobiodiversity when local varieties cannot be used any more because seed stocks are contaminated.

Contamination with GM agrofuel varieties can also have economic effects that reach beyond the individual fields that got contaminated. The rice seed contamination with

LL601 rice in the US from a (later abandoned) field trial, detected only years later by accident has so far cost up to 1.2 billion dollars, not including damage compensation claims by farmers. The US rice export is still suffering even though in this case it was possible to develop a test quite soon. For smaller economies, the loss of a major export market will have even higher impacts on the national economy.

Conclusions

Conventional and GM agrofuels are cultivated in large-scale, industrialized agricultural settings. Models of the cultivation of GM crops in general have to reduce their scope on specific questions like factors that influence the spread of pollen, or the percentage of GM contamination over given distances. However the cultivation of GM agrofuel crops in large scale industrialized agriculture will add factors that are currently not included in the models, like soci-economic effects or human rights issues. In addition, the cultivation of non-edible GM agrofuel crops can threaten food safety and food security. In this case, models focusing on probabilities and percentages of contamination could offer a false sense of security. Instead the additional risks of GM agrofuel crops need to be acknowledged in the models.

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