

Case study: Industry influence in the risk assessment of genetically engineered maize 1507

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Zusammenfassung

Ziel des Berichts ist es, zu überprüfen, wie groß der Einfluss der Industrie auf die Risikobewertung gentechnisch veränderter Pflanzen ist. Beispielhaft wurde hierfür der Gentechnik-Mais 1507 gewählt, der gemeinsam von Dow AgroSciences und Pioneer Hi-Bred / DuPont entwickelt wurde und das Insektengift Cry1F produziert.

Im Rahmen dieser Fallstudie zum Mais 1507 soll untersucht werden, wie viele wirklich unabhängige wissenschaftliche Publikationen verfügbar sind, auf die sich eine realistische Risikobewertung stützen kann. Dazu wurde zunächst eine Literaturrecherche durchgeführt. Die identifizierten Studien wurden anschließend in Bereiche unterteilt, die für die Risikobewertung wichtig sind. In einem nächsten Schritt wurden Studien identifiziert, die aus einem industrienahen Forschungsumfeld stammen und deswegen möglicherweise in Fragestellung und Ergebnissen entsprechend beeinflusst wurden. Die wichtigsten Kriterien, um einen Einfluss der Industrie zu identifizieren, waren:

- Untersuchungen, die von Experten durchgeführt wurden, die direkt bei der Industrie angestellt waren (auch „Industriestudien“ genannt).
- Untersuchungen, die von der Industrie finanziert wurden oder an denen Wissenschaftler mitgewirkt haben, die bei der Industrie angestellt waren.
- Untersuchungen, die von Wissenschaftlern durchgeführt wurden, die enge Verbindungen zur Industrie haben.

Hier die Zusammenfassung der wichtigsten Ergebnisse:

- Es gibt nur sehr wenige Studien zum Mais 1507 oder zu anderen gentechnisch veränderten Maispflanzen, die das Insektengift Cry1F produzieren, die nicht offensichtlich von der Industrie beeinflusst sind. Von 92 Studien, die von spezifischem Interesse für die Risikobewertung von Mais 1507 gelten können, war es nur bei 15 Studien (16 Prozent) unwahrscheinlich, dass diese durch die Hersteller des Mais 1507 beeinflusst wurden. In einigen Fällen konnten wir kein eindeutiges Urteil fällen, weil sich in den Studien keine ausreichenden Informationen über das Ausmaß der „Unterstützung“ (wie z.B. der Bereitstellung von Saatgut) durch die Industrie finden.
- Die meisten der Studien (57), die sich mit Mais 1507 befassen, untersuchen die Wirkung dieser Maislinie auf Schadinsekten und die Entstehung von Resistenzen. Diese Fragen sind vor allem von wirtschaftlicher Bedeutung und damit vor allem für die Konzerne interessant, die diesen Mais entwickelt und produziert haben. Zu anderen Bereichen der

Risikobewertung gibt es dagegen nur sehr wenige nach wissenschaftlichen Standards (peer reviewed) veröffentlichte Studien, so zum Beispiel insgesamt nur 18 Studien zu Auswirkungen auf sogenannte „Nichtzielorganismen“ wie Bodenorganismen, Nutzinsekten und geschützte Insekten. Gar keine entsprechenden Peer-reviewed-Publikationen gibt es zur Untersuchung des Genoms und zu ungewollten Veränderungen in den Inhaltsstoffen der Pflanzen. Bei den Fütterungsstudien gibt es ein paar Peer-reviewed-Publikationen, die aber alle von der Industrie durchgeführt wurden.

- Die Erforschung der Umweltrisiken des Mais 1507 und des Toxins Cry1F wird von einem Netzwerk von Wissenschaftlern dominiert, die nicht direkt bei der Industrie angestellt sind, jedoch enge Verbindungen zu ihr haben. Ein Beispiel ist hier Blair D. Siegfried, der auf Patenten der Firma Dow auf das Toxin Cry1F als Erfinder genannt wird und gleichzeitig an 15 der relevanten Studien als „unabhängiger Wissenschaftler“ beteiligt war.
- In ihrer Risikobewertung hat die Europäische Lebensmittelbehörde EFSA mögliche Einflüsse durch die Industrie nicht berücksichtigt. Im Gegenteil, die EFSA trug vielmehr aktiv dazu bei, dass die Einseitigkeit der Risikobewertung sogar noch verstärkt wurde: So wurde aus den vorliegenden Publikationen zum Teil selektiv zitiert und es wurden Befunde weggelassen, die auf ein erhöhtes Risiko für geschützte Schmetterlinge hinweisen. Zudem wurden Veröffentlichungen von einigen Experten der EFSA, von denen vermutet wird, dass sie Verbindungen zur Industrie haben, zum zentralen Bestandteil der Risikobewertung gemacht.

Im Ergebnis zeigt unsere Analyse nicht nur einen erheblichen Mangel an wissenschaftlich publizierten Daten, sondern auch einen erdrückenden Einfluss der Industrie auf die Forschung zu Mais 1507.

Summary

The aim of this report is to evaluate how much influence industry has on the risk assessment of genetically engineered crops, in particular maize 1507 jointly developed by Dow AgroSciences and Pioneer Hi-Bred / DuPont.

Maize 1507 was used in this case study to assess the availability of industry independent peer-reviewed data. Initially we conducted a literature search. Studies were identified and then classified according to issues relevant to risk assessment. The next step involved identifying studies influenced by industry networks which therefore might be biased by vested interests. The most relevant criteria in identifying industry influence were:

- studies conducted by scientists employed by industry (also called 'industry study'),
- studies funded by industry or co-authored by industry scientists,
- Studies conducted by scientists with close ties to industry.

The main findings are:

- there are very few studies on maize 1507 or other crops containing Cry1F protein that have not been obviously influenced by industry. Of 92 studies that were found to contribute to the risk assessment of maize 1507, only 15 (~16%) were unlikely to have been impacted by industry bias. In some cases, we were unable to reach a definite conclusion on possible industry influence because there was no information on funding available or the amount of industry "support", apart from supplying seeds or other inputs was not made clear in the papers.
- most of the studies on maize 1507 (57) examined the effects on pest insects (target organisms) or insect resistance. These data are mostly of economic relevance. In the other areas of risk assessment there is very little peer-reviewed data (for example, there are only 18 studies on non-target organisms), or no peer-reviewed data at all (information on molecular data and composition). In the areas of nutritional studies and toxicity/allergenicity testing, all the peer-reviewed studies were conducted by industry.
- research on the environmental risks of maize 1507 or Cry1F protein is dominated by a network of scientists who are not employed by industry but have strong links to industry. One example is Blair D. Siegfried who is the inventor behind patents on Cry1F toxin held by Dow, one of the developers of maize 1507, and who at the same time conducted 15 studies on Cry1F as an "independent" scientist. This apparent conflict of interest is never mentioned in any of Siegfried's papers on Cry1F.
- In its risk assessment, EFSA did not consider any possible bias of the available publications. EFSA in fact aggravated the problem by selectively referencing relevant findings and by introducing publications written by some of its own or other experts who are

assumed to have links with industry.

The analysis of peer-reviewed data on maize 1507 / Cry1F maize has not only revealed a major gap in independent data, but that industry has a great deal of influence and scientific networks work too closely with industry.

1. Introduction

Maize 1507 was assessed by the European Food Safety Authority (EFSA), and the EU Commission is in favour of its market authorisation. We investigated the actual amount of peer-reviewed data available for the risk assessment of maize 1507. Initially we conducted a literature search which comprised the publications referenced by the European Food Safety Agency (EFSA), as well as other studies found in scientific databases. The purpose of this examination was

- to identify the number of peer-reviewed papers available for the risk assessment of maize 1507,
- to determine the areas lacking publicly available data on maize 1507,
- to determine the number of studies conducted in a scientific environment likely to be influenced by industry (such as publications by scientists employed in industry or research funded by industry or conducted by scientists with strong links to industry).

2. Method

The search for peer-reviewed studies was conducted using „Google Scholar“, „PubMed“ and „WorldWideScience“ databases. We used the search terms „Cry1F“and „maize 1507“. Results were considered if they were of importance for risk assessment, and our own findings were compared with relevant EFSA opinions (EFSA, 2005, 2006, 2008, 2011, 2012). The intention of this first step was to identify possible gaps in peer-reviewed science in the risk assessment of maize 1507. For this purpose, publications were classified according to issues relevant for risk assessment.

The next step of the assessment was to identify studies conducted within a scientific environment close to industry. Criteria for industry influence were:

- studies conducted by scientists employed by industry (also called 'industry study'),
- studies funded by industry or co-authored by industry scientists,
- studies conducted by scientists with close ties to industry.

While the first two criteria are more or less self-evident, the third is a matter of definition and is therefore discussed in more detail in chapter 4.

3. Findings

3.1 Molecular data

No peer-reviewed papers on the molecular characterisation of maize 1507 could be identified. The papers available are only so-called grey literature, prepared by industry for their market application but not published in peer-reviewed journals. The only two studies that dealt with Cry1F were on cotton and conducted by industry. Consequently, there are no peer-reviewed publications regarding the molecular characterisation of maize 1507.

3.2 Composition

No peer-reviewed publications on the composition of maize 1507 could be identified. The papers available are only so-called grey literature, prepared by industry for their market application but not published in peer-reviewed journals.

3.3 Nutritional studies

Four studies were identified which contributed to the nutritional assessment of maize 1507 (Faust et al. 2007; Scheideler et al., 2008; Sindt et al., 2007; Stein et al., 2009). All the studies were conducted by scientists employed by either Pioneer or Dow AgroSciences (see Appendix 1).

3.4 Toxicity – allergenicity

Five peer-reviewed studies were identified which contributed to the toxicity or allergenicity testing of maize 1507 (see Appendix 2). Two papers deal specifically with maize 1507 (Ladics et al., 2006; MacKenzie et al., 2007). The Appenzeller et al. (2009) paper is included here although this study was conducted using a stacked event (1507 x DAS 59122). All three of the studies mentioned above were conducted by scientists working in the industry. Two other studies are also included here which examined a different maize line (DP4113) that produces Cry1F (Delaney et al., 2013; Hardisty et al., 2013). Delaney et al. (scientists employed by DuPont Pioneer) found signs of cancerogenicity in maize DP4113. These findings were scrutinised by an expert panel convened by DuPont. The results of the expert panel analysis were published by Hardisty et al. (2013), and funded by DuPont. All five peer-reviewed papers on maize 1507 were therefore conducted or funded by industry.

3.5 Environmental risk assessment

3.5.1. Target organisms – efficacy, insect resistance

More than half of all the published studies with maize 1507 or Cry1F examined the effects on pest

insects (target organisms). Most of the studies investigated the issue of possible resistance in those insects, an aspect that would be of economic relevance. This is in contrast to the poor data in all other areas of risk assessment.

Of the 59 studies identified (see Appendix 3), one study could not be accessed (number 33); in one case (number 3) there was no information on funding. Accordingly, no statement on possible influence can be made.

Four studies were identified that were supported by industry (for example by supplying seeds), but no other information on possible corporate influence is given (numbers 17, 34, 54, 55). As most studies stem from the US, the independence of these studies is questionable due to the well-known industry control of patented transgenic plants (see for example Waltz, 2009). These studies are categorised here as “supported by industry”, because no final assessment of industry influence could be made.

Of the remaining 53 studies, only 10 studies not obviously influenced by industry could be identified. The remaining 43 studies were either conducted by scientists employed by industry, funded by industry, co-authored by industry scientists or conducted by authors with links to industry.

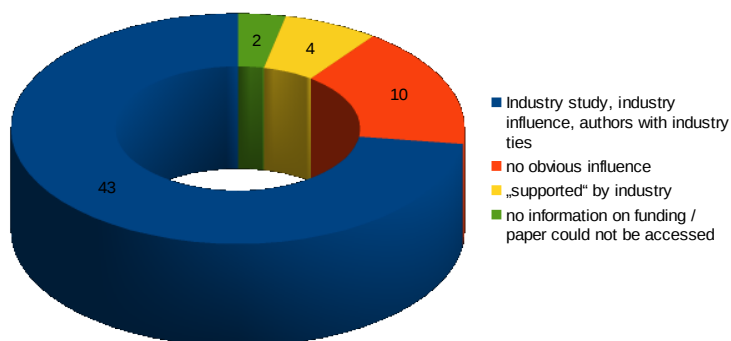


Figure 1: 'Independent' and 'industry influenced' studies on maize 1507 regarding target organisms

3.5.2 Non-target organisms

Overall, there are only 18 published studies on non-target organisms (see Figure 3; Appendix 4). However, one study (number 9) is only a conference abstract and is therefore omitted here.

One study was identified which was supported by industry (seeds were supplied by Monsanto and Pioneer), but no other information on possible corporate influence was given (number 2).

Twelve studies were identified which were authored by scientists with ties to industry, eleven of these studies by a network of mainly US scientists who collaborate frequently (see chapter 4). One of the papers (Perry et al., 2012) is authored mainly by current or former EFSA experts. Several of

these scientists also have ties to industry or industry orientated organisations.¹

One of the remaining papers which might be considered independent (Hanley et al., 2003), identified a highly sensitive model organism (greater wax moth, *Galleria mellonella*). This indicates that European butterflies might be highly sensitive to the toxin Cry1F and consequently more investigations would have been necessary. However, EFSA (2005) omitted this finding from its risk assessment.

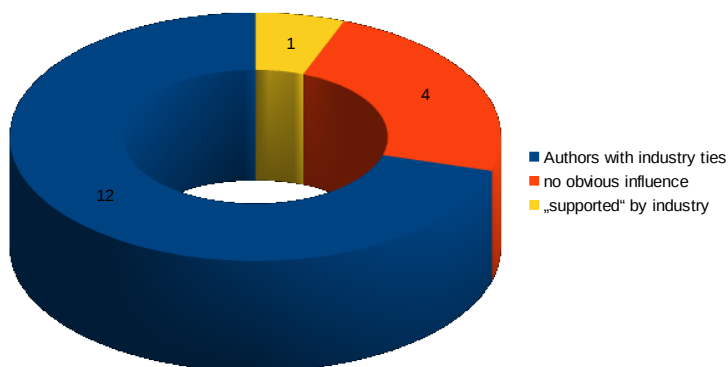


Figure 2: 'Independent' and 'industry influenced' studies on maize 1507 regarding non-target organisms

3.5.3 Soil / Microorganisms

Seven peer-reviewed papers have been published to date specifically on maize 1507 (see Figure 3; Appendix 5). Three of the seven studies were performed by scientists employed by industry; in two others there was an identifiable influence from industry.

There were only two studies where no obvious influence from industry could be identified. In one of these studies, Blackwood & Buyer (both authors USDA employees) investigated the effects of different Bt maize lines on community structure in soil. However, the paper suffers from the fact that it is only a short term study.

For one paper, funding sources remain unclear. The Cotta et al. (2013) study was funded by the Soil Biotechnology Foundation. No information on this foundation could be retrieved.

¹ http://corporateeurope.org/sites/default/files/publications/amflora_coi_report_2011.pdf
<http://www.testbiotech.de/node/785>

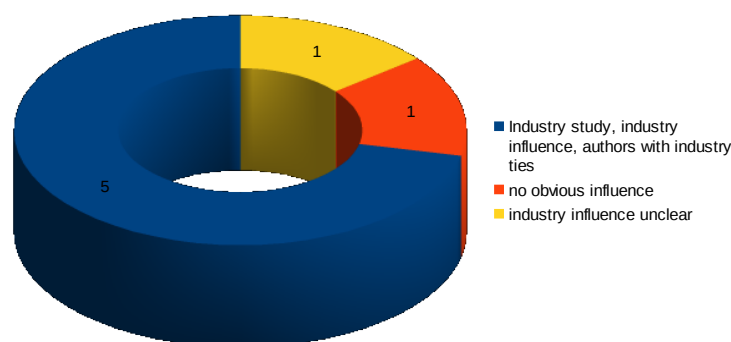


Figure 3: 'Independent' and 'industry influenced' studies on maize 1507 regarding soil/microorganisms

4. Network of scientists involved in risk assessment of maize 1507 too close to industry

Analysis of peer-reviewed studies also revealed a network of mostly publicly funded scientists who were involved in a large proportion of the available scientific literature on Cry1F maize. Many members of this network, who have been collaborating extensively, have close ties to industry or industry think tanks such as the *International Life Sciences Institute* (ILSI) (see appendix 6). Examples are:

- **Eric C. Burkness** conducted studies with (partly) industry funding (Burkness et al., 2010)
- **Galen P. Dively** conducted studies with industry funding (Dively, 2005) and is co-author of papers authored by scientists working in industry (Naranjo et al., 2005; Storer et al., 2008; Duan et al., 2008)
- **Richard L. Hellmich** is co-author of several ILSI publications (Carstens et al., 2013; Huesing et al, 2008; Romeis et al., 2008), a member of a Monsanto Advisory Committee (Corn Rootworm Knowledge Research Program)² and was funded by industry i.e. Monsanto³
- **William D. Hutchison** is a beneficiary of grants from Syngenta, Monsanto, Pioneer⁴ and

² <http://www.monsanto.com/crwknowledge/pages/advisory-committee.aspx>

³ <http://ageconsearch.umn.edu/bitstream/21606/1/sp99hu04.pdf>

⁴ http://experts.umn.edu/expertGrants.asp?n=William+D+Hutchison&u_id=1228&oe_id=1&o_id=81

co-author of studies funded by industry (Burkness et al., 2010)

- **Jörg Romeis** is co-author of ILSI publications, (Romeis et al., 2011), organiser of ILSI workshops ⁵, co-author of studies with industry scientists (Romeis et al., 2008) and a member of PRRI, a lobby group founded by Klaus Ammann and other pro-GM scientists (PRRI was sponsored by the Syngenta Foundation, CropLife International, US Grain Council, Monsanto and Arborgen^{6 7})
- **Mark K. Sears** conducted studies with industry scientists (Romeis et al, 2008; Wolt et al., 2010), and is co-author of a ILSI publication (Wolt et al., 2010)
- **Anthony Shelton** co-authored studies with industry scientists (Romeis et al, 2008, 2011) and was a consultant to the Agricultural Biotechnology Stewardship Committee, which consists of Dow, Monsanto, DuPont, Syngenta (1998-2002)⁸
- **Blair D. Siegfried** is a member of a Monsanto Advisory Committee (Corn Rootworm Knowledge Research Program)⁹ and conducted studies with industry scientists (Siegfried et al., 2013), he served as an expert on an International Life Sciences Institute (ILSI) Panel („Evaluation of Insect Resistance Management in Bt Field Corn: A Science-Based Framework for Risk Assessment and Risk Management“)¹⁰; he is further an inventor of patents on Cry1F (“Combinations of Cry1Ab and Cry1Fa as an insect resistance management tool”) held by Dow¹¹
- **Jeffrey D. Wolt** is a former employee of Dow AgroSciences (from about 1990¹² to 2003¹³), conducted studies with industry scientists (Wolt et al., 2010; Herman et al., 2002; Gealy et al., 2007; Huesing et al., 2011; Shan et al., 2005; Romeis et al., 2008), is a member of PRRI¹⁴ and co-author of an ILSI publication (Wolt et al., 2010).

⁵ CERA (2012) Surrogate Species Selection for Assessing Potential Adverse Environmental Impacts of Genetically Engineered Plants on Non-Target Organisms, Conference Proceedings, June 26 - 28, 2012. http://cera-gmc.org/docs/cera_publications/pub_03_2010.pdf

⁶ <http://www.ppri.net/ppri-members/>

⁷ http://web.archive.org/web/20090709062104/http://pubresreg.org/index.php?option=com_content&task=view&id=12&Itemid=29

⁸ <http://files.campus.edublogs.org/blogs.cornell.edu/dist/2/2140/files/2012/04/AMS-CV-ww50qb.pdf>

⁹ <http://www.monsanto.com/crwknowledge/pages/advisory-committee.aspx>

¹⁰ <http://entomology.unl.edu/faculty/siegfried.shtml>

¹¹ https://www.google.de/patents/US20070006340?dq=ininventor:blair+ininventor:siegfried&hl=en&sa=X&ei=2xIOU9G_N8jGtAbciCoAQ&ved=0CE0Q6AEwAw
https://www.google.de/patents/US20080311096?dq=ininventor:blair+ininventor:siegfried&hl=en&sa=X&ei=2xIOU9G_N8jGtAbciCoAQ&ved=0CEYQ6AEwAg

¹² <http://www.jstor.org/discover/10.2307/3986773?uid=3737864&uid=2&uid=4&sid=21103456584341>

¹³ <http://www.bioone.org/doi/abs/10.1603/0046-225X-32.2.237?journalCode=enve>

¹⁴ <http://www.ppri.net/ppri-members/>

Eleven of 18 (17 if one conference abstract is omitted) studies covering the possible effects of Cry1F /maize 1507 on non-target organisms were conducted by one or several members of this group.

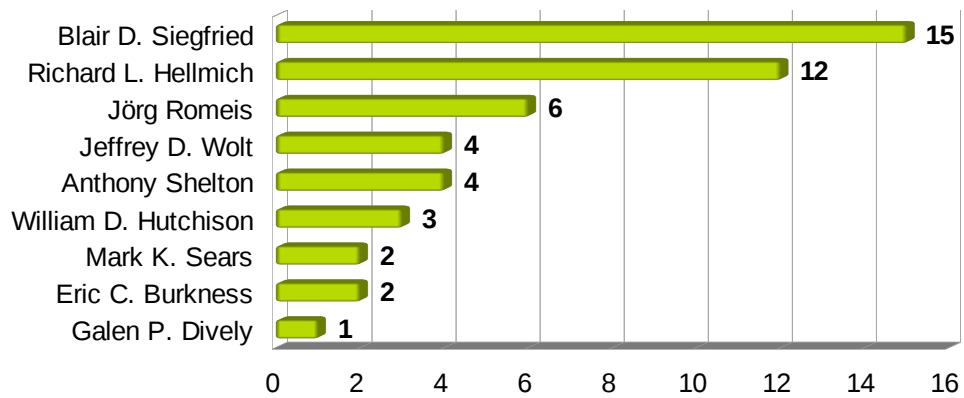


Figure 4: Studies on maize 1507 / Cry1F; involvement of named scientists

These scientists also worked on a large proportion of the overall body of scientific studies on maize 1507 or other maize varieties expressing Cry1F (see figure 4).

Another group of publications which were assumed to be crucial for the risk assessment of maize 1507 regarding European butterflies were conducted by former or recent members of the EFSA expert panel who also have links to industry. These publications were contested by other authors (Holst et al., 2013, Camastra et al., 2013) so that EFSA had to make a judgment on a publication which was prepared by some of its own experts.

5. Discussion

Overall, **92** studies could be identified that contributed to the risk assessment of maize 1507 (see table 1).

Area of risk assessment	Sum	Industry study, industry influence, authors with industry ties	No obvious influence	„Supported“ by industry (influence unclear)	Paper could not be accessed, no information on funding
Molecular data	0	0	0	0	0
Composition	0	0	0	0	0
Nutritional equivalence	4	4	0	0	0
Toxicity/Allergenicity	5	5	0	0	0
ERA: Target organisms/IRM	59	43	10	4	2
ERA: Non-target organisms	17	12	4	1	0
ERA: Soil/microorganisms	7	5	1	1	0
Sum	92	69	15	6	2

Table 1: Peer-reviewed studies on maize 1507 / Cry1F maize

These results confirm previous reports showing there is only a limited amount of scientific data available on this genetically engineered maize (Then & Bauer-Panskus, 2013). There are no peer-reviewed studies at all regarding molecular data and composition. In other areas of risk assessment such as nutritional equivalence or toxicity testing, all the available studies were conducted by industry. In the area of environmental risk assessment, the literature search revealed that most publications (59) examined the effects of maize 1507 on target organisms or insect resistance. In contrast, there are only a few studies examining the effects of maize 1507 on non-target organisms. As noted before, there is not a single experimental study measuring the effects of maize 1507 on European non-target lepidoptera (Then & Bauer-Panskus, 2013). Further, of 17 studies on non-target organisms, 12 studies were conducted by scientists with strong links to industry. In addition, a high percentage of the studies examining the effects on soil or microorganisms cannot be deemed independent of industry.

The literature search on maize 1507 also revealed a limited overall number of scientists who have conducted studies on maize 1507 / Cry1F maize. A network of scientists who have collaborated frequently for several years and have close ties to industry is responsible for a large proportion of studies in the area of environmental risk assessment. For example, members of this network were involved in 11 of 17 available studies on the effects of maize 1507 / Cry1F maize on non-target organisms. One possible explanation for the observed bias in the research landscape could be that

industry only granted a small group of scientists access to research material. Eminent examples of such “independent” scientists are Blair D. Siegfried, who is an inventor of patents on Cry1F held by Dow, or Jeffrey Wolt, who was a Dow employee for many years. The case of Blair D. Siegfried must be regarded as very serious, since his conflicts of interest are not declared in any of his scientific studies regarding the risk assessment of Cry1F.

EFSA conducted its risk assessment without considering possible bias in the data and there was no discussion on whether further independent research was needed. EFSA's own activities went even further in this respect: The Hanley et al. (2003) publication is one of the very few studies on non-target organisms which is not obviously influenced by industry. This publication presents two investigations: One on honey bees and one on the greater wax moth. This moth is an important model organism for assessing risks in non-target butterflies. Hanley et al. (2003) did not find any adverse effects in honey bees. However, the findings in the greater wax moth investigation are alarming. The greater wax moth is much more sensitive to the toxin produced by maize 1507 than expected. In consequence, the risks for European butterflies are also likely to be higher than assumed and intensive investigations are necessary to assess the true risks for the various species. These alarming findings were not even mentioned by EFSA in its initial assessment (EFSA, 2005) and it thus appears that EFSA selectively picked results favouring industry and omitted those identifying highly relevant risks to non-target organisms.

Further, a network of scientists of former or current members of the EFSA GMO expert panel who also have some links to industry published papers on computer modelling of risks for European butterflies (Perry et al., 2012, 2013). These publications come to the conclusion that exposure of larvae of European butterflies to the toxin Cry1F can be estimated as low. These findings (regarding also a related model on Cry1Ab) were contested by other scientists (Holst et al., 2013) who are of the opinion that more empirical investigations would be needed to come to any conclusion. Nevertheless, EFSA regarded these publications by its own experts as sufficient to assume that risks for European butterflies were unlikely – without a single peer-reviewed empirical study to prove this assumption.

Findings in the case of maize 1507 raise substantial questions about risk research and the risk assessment of genetically engineered plants. EU Directive 2001/18 requires that

“Member States and the Commission should ensure that systematic and independent research on the potential risks involved in the deliberate release or the placing on the market of GMOs is conducted.” (Recital 21)

This requirement is obviously not fulfilled in the case of maize 1507. On the contrary, the landscape in the risk research of genetically engineered plants is distorted by a major bias towards vested interests of companies marketing these plants.

6. Conclusions and recommendations

This case study shows that there is a huge lack of data and that industry has considerable influence over the research on genetically engineered maize 1507. Therefore, from the data available no conclusions can be made upon safety of these plants for human or animal consumption or the environment.

EU regulations 178/ 2002, 1829/2003 and 2001/18 require a high level of protection for consumers and the environment. These standards cannot be fulfilled if basic data are missing and there are hardly any peer-reviewed data available that are not compromised by the vested interests of the companies producing these plants.

Major changes are needed in the current EFSA practice of risk assessment and research policy within the EU. While so far the EU Commission and many national governments have placed much emphasis on supporting technology, competition and innovation, there has never been a similar push for a more coherent and effective approach to improve food safety.

Solutions to this problem should include the systematic promotion of independent risk research. Funding needs to be organised to support scientists and institutions who are not working for industry to ensure the risks of new products and new technologies are investigated in line with the precautionary principle. Industry should be involved in raising new funds for independent research while civil society organisations active in relevant fields (such as the protection of the environment) should be involved in the allocation of funds. At the same time there should be a strict avoidance of any influence exerted by vested economic interest. Improving the degree of independence of authorities involved in risk assessment and the process of authorisation is a further crucial issue. Heterogeneity of the relevant committees and the panels should be a priority in selecting the experts. In many cases, scientific truth is not a matter of the expertise of individual experts but the result of a proper and even controversial debate amongst experts. This is especially true when it comes to identifying the limits of knowledge and the extent of uncertainties. There should be a requirement for the integration of a 'second opinion', independent from the current authorities such as EFSA. These 'second opinions' should have a specific focus on the precautionary principle, be reliable and not driven by vested economic interests in the outcome of risk analysis. For example, the European Environment Agency should have a decisive role in assessing environmental risks.

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Appendix 1 - Nutritional studies

Authors of publication	Title of publication	Journal	Year	Industry influence
Faust, M., Smith, B., Rice, D., Owens, F., Hinds, M., Dana, G., Hunst, P.	Performance of lactating dairy cows fed silage and grain from a maize hybrid with the cry1F trait versus its non-biotech counterpart	Journal of Dairy Science	2007	Industry study (Dow, Pioneer)
Scheideler, S.E., Rice, D., Smith, B., Dana, G., Sauber, T.	Evaluation of nutritional equivalency of corn grain from DAS-1507-1 (Herculex I) in the diets of laying hens	Journal of Applied Poultry Research	2008	Industry study (Pioneer)
Sindt, J., Drouillard, J., Loe, E., Kessen, T., Sulpizio, M., Montgomery, S., Rice, D., Hinds, M., Smith, B., Owens, F., Dana, G., Hunst, P.	Effect of corn containing the Cry1F protein on performance of beef heifers fed a finishing diet based on steam-flaked corn	Professional Animal Scientist	2007	Industry study (Pioneer)
Stein, H.H., Sauber, T.E., Rice, D.W., Hinds, M.A., Smith, B.L., Dana, G., Peters, D.N., Hunst P	Growth performance and carcass composition of pigs fed corn grain from DAS-1507-1 (Herculex I) hybrids	Professional Animal Scientist	2009	Industry study (Pioneer)

Appendix 2 - Toxicity / Allergenicity

Authors of publication	Title of publication	Journal	Year	Industry influence
Appenzeller LM, Malley L, MacKenzie SA, Hoban D, Delaney B	Subchronic feeding study with genetically modified stacked trait lepidopteran and coleopteran resistant (DAS-1507-1 + DAS-59122-7) maize grain in Sprague-Dawley rats	Food and Chemical Toxicology	2009	Industry Study: Pioneer, DuPont
Delaney, B., Karaman, S., Roper, J., Hoban, D., Sykes, G., Mukerji, P., & Frame, S. R.	Thirteen week rodent feeding study with grain from molecular stacked trait lepidopteran and coleopteran protected (DP-ØØ4114-3) maize	Food and Chemical Toxicology, 53, 417-427.	2013	Industry Study: Pioneer, DuPont
Hardisty, J. F., Banas, D. A., Gopinath, C., Hall, W. C., Hard, G. C., & Takahashi, M.	Spontaneous renal tumors in two rats from a thirteen week rodent feeding study with grain from molecular stacked trait lepidopteran and coleopteran resistant (DP-ØØ4114-3) maize	Food and Chemical Toxicology, 53, 428-431.	2013	Sponsored by DuPont
Ladics, G.S., Bardina, L., Cressman, R.F., Mattsson, J.L., Sampson, H.A.	Lack of cross-reactivity between the Bacillus thuringiensis derived protein Cry1F in maize grain and dust mite Der p7 protein with human sera positive for Der p7-IgE	Regulatory Toxicology and Pharmacology	2006	Industry scientists involved No information on funding
MacKenzie, S.A., Lamb, I., Schmidt, J., Deege, L., Morrisey, M.J., Harper, M., Layton, R.J., Prochaska, L.M., Sanders, C., Locke, M., Mattsson, J.L., Fuentes, A., Delaney, B.	Thirteen week feeding study with transgenic maize grain containing event DAS-1507-1 in Sprague-Dawley rats	Food and Chemical Toxicology	2007	Industry Study: Pioneer, DuPont

Appendix 3 - Target organisms – efficacy, insect resistance

	Authors of publication	Title of publication	Journal	Year	Industry influence
1	Binning, R.R., Coats, J., Kong, X., Hellmich, R.L.	Susceptibility and Aversion of Spodoptera frugiperda (Lepidoptera: Noctuidae) to Cry1F Bt Maize and Considerations for Insect Resistance Management	Journal of Economic Entomology, 107(1), 368-374	2014	Industry scientists involved: Binning, Kong (Pioneer); Author with industry ties: (Hellmich) DuPont Pioneer provided maize seed, laboratory space, and supplies
2	Bohnenblust, E., Breining, J., Fleischer, S., Roth, G., Tooker, J.	Corn Earworm (Lepidoptera: Noctuidae) in Northeastern Field Corn: Infestation Levels and the Value of Transgenic Hybrids	Journal of Economic Entomology, 106(3), 1250-1259.	2013	No obvious influence
3	Buntin, G.D.	Corn expressing cry1ab or cry1f endotoxin for fall armyworm and corn earworm (Lepidoptera: noctuidae) management in field corn for grain production	Florida Entomologist	2008	No information on funding
4	Burkness, E.C., O'Rourke, P.K., Hutchison, W.D.	Cross-pollination of nontransgenic corn ears with transgenic Bt corn: efficacy against lepidopteran pests and implications for resistance management	Journal of Economic Entomology	2011	Authors with industry ties: Hutchison, Burkness
5	Buschman, L.L., Ramaswamy, S.B.	How to build the non-host plant for stability in insect resistance management	GM Crops and Food	2012	No obvious influence
6	Coates, B.S., Sumerford, D.V., Lopez, M.D, Wang, H., Fraser, L.M., Kroemer, J.A., Spencer, T., Kim, K.S., Abel, C.A., Hellmich, R.L., Siegfried, B.D.	A single major QTL controls expression of larval Cry1F resistance trait in <i>Ostrinia nubilalis</i> (Lepidoptera: Crambidae) and is independent of midgut receptor genes	Genetica	2011	Authors with industry ties: Hellmich, Siegfried Switched to industry (Monsanto) in 2013: Coates
7	Crava, C. M., Bel, Y., Jakubowska, A. K., Ferré, J., Escriche, B.	Midgut aminopeptidase N isoforms from <i>Ostrinia nubilalis</i> : Activity characterization and differential binding to Cry1Ab and Cry1Fa proteins from <i>Bacillus thuringiensis</i> .	Insect Biochemistry and Molecular Biology, 43(10), 924-935.	2013	No obvious influence
8	Crespo, A.L.B., Rodrigo-Simon, A., Siqueira, H.A.A., Pereira, E.J.G., Ferre, J.S., Siegfried, B.D.	Cross-resistance and mechanism of resistance to Cry1Ab toxin from <i>Bacillus thuringiensis</i> in a field-derived strain of European corn borer <i>Ostrinia nubilalis</i>	Journal of Invertebrate Pathology	2011	Authors with industry ties: Siegfried
9	Eichenseer, H., Strohbehn, R., Burks, J.	Frequency and severity of western bean cutworm (Lepidoptera: Noctuidae) ear damage in transgenic corn hybrids expressing different <i>Bacillus thuringiensis</i> cry toxins	Journal of Economic Entomology	2008	Industry study (Pioneer)
10	Farinos, G.P., de la Poza, M., Ortego, F., Castanera, P.	Susceptibility to the Cry1F toxin of field populations of <i>Sesamia nonagrioides</i> (Lepidoptera: Noctuidae) in mediterranean maize cultivation regions	Journal of Economic Entomology	2012	No obvious influence
11	Gaspers C, Siegfried BD, Spencer T, Alves AP, Storer NP, Schuphan I, Eber S	Susceptibility of European and North American populations of the European corn borer to the Cry1F insecticidal protein	Journal of Applied Entomology	2011	Industry scientists (Alves, Storer), scientists with ties to industry (Siegfried, Schuphan)
12	Ghimire, M.N., Huang, F., Leonard, R., Head, G.P., Yang, Y.	Susceptibility of Cry1Ab-susceptible and -resistant sugarcane borer to transgenic corn plants containing single or pyramided <i>Bacillus thuringiensis</i> genes	Crop Protection	2011	Funded by industry; industry scientists (Head, Monsanto)
13	González-Cabrera, J., Farinos G.P., Caccia, S., Díaz-Mendoza, M., Castanera, P., Leonardi G., Giordana, B., Ferré, J.	Toxicity and mode of action of <i>Bacillus thuringiensis</i> Cry proteins in the Mediterranean corn borer, <i>Sesamia nonagrioides</i> (Lefebvre)	Appl. Environm. Microbiol., 72, 2594-2600.	2006	No obvious influence (EU project QLRT-2001-01969)

	Authors of publication	Title of publication	Journal	Year	Industry influence
14	Gouffon, C., Van Vliet, A., Van Rie, J., Jansens, S., Jurat-Fuentes, J.L.	Binding sites for <i>Bacillus thuringiensis</i> Cry2Ae toxin on heliothine brush border membrane vesicles are not shared with Cry1A, Cry1F, or Vip3A toxin	Applied and Environmental Microbiology	2011	Funded by Bayer BioScience
15	Hardke, J.T., Leonard, B.R., Huang, F., Jackson, R.E.	Damage and survivorship of fall armyworm (Lepidoptera: Noctuidae) on transgenic field corn expressing <i>Bacillus thuringiensis</i> Cry proteins	Crop Protection	2011	Funded by: Louisiana Soybean and Feed Grain Promotion Board, Monsanto, Dow AgroSciences
16	Head, G.P., Greenplate, J.	The design and implementation of insect resistance management programs for Bt crops	GM Crops and Food	2012	Industry study (Monsanto)
17	Hernández-Martínez, P., Hernández-Rodríguez, C.S., Krishnan, V., Crickmore, N., Escriche, B., Ferré, J.	Lack of Cry1Fa binding to the midgut brush border membrane in a resistant colony of <i>Plutella xylostella</i> moths with a mutation in the ABC22 locus	Applied and environmental microbiology, 78(18), 6759-6761.	2012	Research material provided by industry (Bayer)
18	Hernández-Rodríguez, C.S., Hernández-Martínez, P., Van Rie, J., Escriche, B., Ferré, J.	Shared midgut binding sites for Cry1A. 105, Cry1Aa, Cry1Ab, Cry1Ac and Cry1Fa proteins from <i>Bacillus thuringiensis</i> in two important corn pests, <i>Ostrinia nubilalis</i> and <i>Spodoptera frugiperda</i>	PloS One, 8(7), e68164.	2013	Study funded by Bayer, Bayer scientists and consultants involved
19	Hutchison, W., Burkness, E., Mitchell, P., Moon, R., Leslie, T., Fleischer, S., Abrahamson, M., Hamilton, K.L., Steffey, K.L., Gray M.E., Hellmich, R.L., Kaster, L.V., Hunt, T.E., Wright, R.J., Pecinovsky, K., Rabaey, T.L., Flood, R.B., Raun, E.S.	Areawide suppression of European corn borer with Bt maize reaps savings to non-Bt maize growers	Science	2010	Industry authors and authors with industry ties: Hellmich, Hutchison, Burkness, Mitchell (consultant to Monsanto, Pioneer, Syngenta), Industry scientists involved (Kaster, Rabaey, Flood)
20	Ibargutxi, M.A., Munoz, D., de Escudero, I.R. Caballero, P.	Interactions between Cry1Ac, Cry2Ab, and Cry1Fa <i>Bacillus thuringiensis</i> toxins in the cotton pests <i>Helicoverpa armigera</i> (Hübner) and <i>Earias insulana</i> (Boisduval)	Biological Control 47: 89–96.	2008	No obvious influence
21	Kang, J., Onstad, D.W., Hellmich, R.L., Moser, S.E., Hutchison, W.D., Prasifka, J.R.	Modeling the impact of cross-pollination and low toxin expression in corn kernels on adaptation of European corn borer (Lepidoptera: Crambidae) to transgenic insecticidal corn	Transgenic Plants and Insects	2012	Authors with industry ties: Hellmich, Hutchison; Onstad and Prasifka switched to industry
22	Murúa, M. G., García Degano, M. F., Pereira, M., Pero, E., Willink, E., & Gastaminza, G.	Eficacia en campo del maíz Herculex® I para el control de <i>Spodoptera frugiperda</i> (Smith) (Lepidoptera: Noctuidae) en el Noroeste Argentino	Revista industrial y agrícola de Tucumán, 90(1), 37-43.	2013	No obvious influence
23	Nais, J., Busoli, A. C., & Michelotto, M. D.	Behavior of transgenic maize hybrids and their conventional isogenic counterparts in relation to infestation of <i>Spodoptera Frugiperda</i> (j. E. Smith, 1727)(Lepidoptera: Noctuidae) at two locations and sowing dates	Arquivos do Instituto Biológico, 80(2), 159-167.	2013	No obvious influence
24	Niu, Y., Meagher Jr, R.L., Yang, F., Huang, F.	Susceptibility of field populations of the fall armyworm (Lepidoptera: Noctuidae) from Florida and Puerto Rico to purified Cry1F protein and corn leaf tissue containing single and pyramided Bt genes	Florida Entomologist, 96(3), 701-713.	2013	Partly funded by industry: Louisiana Soybean and Feed Grain Promotion Board
25	Niu, Y., Yang, F., Dangal, V., Huang, F.	Larval survival and plant injury of Cry1F-susceptible, -resistant, and -heterozygous fall armyworm (Lepidoptera: Noctuidae) on non-Bt and Bt corn containing single or pyramided genes	Crop Protection 59: 22-28.	2014	Partly funded by Louisiana Soybean and Feed Grain Promotion Board
26	Oppert, B., Ellis, R.T., Babcock, J.	Effects of Cry1F and Cry34Ab1/35Ab1 on storage pests	Journal of Stored Products Research	2010	Industry scientists involved: Ellis
27	Pereira, E.J.G., Lang, B.A., Storer, N.P., Siegfried, B.D.	Selection for Cry1F resistance in the European corn borer and cross-resistance to other Cry toxins	Entomologia Experimentalis et Applicata	2008	Industry scientists involved: Storer; Authors with industry ties: Siegfried
28	Pereira, E.J.G., Siqueira, H.A.A., Zhuang, M., Storer, N.P., Siegfried, B.D.	Measurements of Cry1F binding and activity of luminal gut proteases in susceptible and Cry1F resistant <i>Ostrinia nubilalis</i> larvae (Lepidoptera: Crambidae)	Journal of Invertebrate Pathology	2010	Industry scientists involved: Storer; Authors with industry ties: Siegfried

	Authors of publication	Title of publication	Journal	Year	Industry influence
29	Pereira, E.J.G., Storer, N.P., Siegfried, B.D.	Fitness costs of Cry1F resistance in laboratory-selected European corn borer (Lepidoptera: Crambidae)	Journal of Applied Entomology	2011	Industry scientists involved: Storer; Authors with industry ties: Siegfried
30	Pereira, E.J.G., Storer, N.P., Siegfried, B.D.	Inheritance of Cry1F resistance in laboratory-selected European corn borer and its survival on transgenic corn expressing the Cry1F toxin	Bulletin of Entomological Research	2008	Industry scientists involved: Storer; Authors with industry ties: Siegfried
31	Petzold-Maxwell, J. L., Siegfried, B. D., Hellmich, R. L., Abel, C. A., Coates, B. S., Spencer, T. A., & Gassmann, A. J.	Effect of Maize Lines on Larval Fitness Costs of Cry1F Resistance in the European Corn Borer (Lepidoptera: Crambidae)	Journal of Economic Entomology, 107(2), 764-772.	2014	Authors with industry ties: Siegfried, Hellmich, Gassmann
32	Razze, J.M., Mason, C.E.	Dispersal behavior of neonate European corn borer (Lepidoptera: Crambidae) on Bt corn	Journal of Economic Entomology	2012	Study funded by Pioneer
33	Reay-Jones, F.P.F., Wiatrak, P.	Evaluation of new transgenic corn hybrids producing multiple Bacillus thuringiensis toxins in South Carolina	Journal of Entomological Science	2011	Publication could not be accessed
34	Reay-Jones, F.P.F., Wiatrak, P., Greene, J.K.	Evaluating the performance of transgenic corn producing Bacillus thuringiensis toxins in South Carolina	Journal of Agricultural and Urban Entomology	2009	Support by Monsanto and Pioneer
35	Rule, D.M., Nolting, S.P., Prasifka, P.L., Storer, N.P., Hopkins, B.W., Scherder, E.F., ... & Hendrix III, W.H.	Efficacy of Pyramided Bt Proteins Cry1F, Cry1A. 105, and Cry2Ab2 Expressed in SmartStax Corn Hybrids Against Lepidopteran Insect Pests in the Northern United States	Journal of Economic Entomology, 107(1), 403-409.	2014	Industry study: Dow
36	Schaafsma, A.W., Holmes, M.L., Whittlecraft, J., Dudley, S.A.	Effectiveness of three Bt corn events against feeding damage by the true armyworm (Pseudaletia unipuncta Haworth)	Canadian Journal of Plant Science	2007	Partly funded by the Ontario Corn Producers Association, Monsanto, Pioneer Hi-bred, Dow AgroSciences,
37	Schmidt, N.R., Haywood, J.M., Bonning, B.C.	Toward the physiological basis for increased Agrotis ipsilon multiple nucleopolyhedrovirus infection following feeding of Agrotis ipsilon larvae on transgenic corn expressing Cry1Fa2	Journal of Invertebrate Pathology	2009	Partly funded by Pioneer Hi-Bred International
38	Siebert, M.W., Babock, J.M., Nolting, S., Santos, A.C., Adamczyk, J.J., Neese, P.A., King, J.E., Jenkins, J.N., McCarty, J., Lorenz, G.M., Fromme, D.D., Lassiter, R.B.	Efficacy of cry1f insecticidal protein in maize and cotton for control of fall armyworm (Lepidoptera: noctuidae)	Florida Entomologist	2008	Industry scientists involved: Siebert, Babock, Nolting (Dow) "The authors gratefully acknowledge the efforts of our many colleagues at Dow AgroSciences, ..."
39	Siebert, M.W., Tindal, K.V., Leonard, B.R., Van Duyn, J.W., Babcock, J.M.	Evaluation of corn hybrids expressing Cry1F (Herculex (R) I insect protection) against fall armyworm (Lepidoptera: Noctuidae) in the southern United States	Journal of Entomological Science	2008	Industry scientists involved: Siebert, Babock (Dow)
40	Siebert MW, Nolting S, Leonard BR, Braxton LB, All JN, Van Duyn JW, Bradley JR, Bacheler J, Huckaba RM	Efficacy of transgenic cotton expressing Cry1Ac and Cry1F insecticidal protein against Heliothines (Lepidoptera: Noctuidae)	Journal of Economic Entomology	2008	Industry scientists involved: Siebert, Nolting, Braxton, Huckaba (Dow) "We acknowledge the efforts of our many colleagues at Dow AgroSciences ..."
41	Siebert, M.W., Nolting, S.P., Hendrix, W., Dhavala, S., Craig, C., Leonard, B.R., Stewart, S.D., All, J., Musser, F.R., Buntin, G.D., Samuel, L.	Evaluation of corn hybrids expressing Cry1F, Cry1A.105, Cry2Ab2, Cry34Ab1/Cry35Ab1, and Cry3Bb1 against southern United States insect pests	Journal of Economic Entomology	2012	Industry study: Dow
42	Siegfried, B.D., Rangasamy, M., Wang, H., Spencer, T., Haridas, C.V., Tenhumberg, B., ... & Storer, N.P.	Estimating the frequency of Cry1F resistance in field populations of the European corn borer (Lepidoptera: Crambidae)	Pest management science.	2013	Partly funded by industry: Dow Support by "Agricultural Biotechnology Stewardship Technical Committee" Industry scientists involved: Storer,

	Authors of publication	Title of publication	Journal	Year	Industry influence
					Authors with industry ties: Siegfried
43	Siegfried, B.D., Hellmich, R.L.	Understanding successful resistance management - The European corn borer and Bt corn in the United States	GM Crops and Food	2012	Authors with industry ties: Siegfried, Hellmich; partly funded by industry (Agricultural Biotechnology Stewardship Technical Committee)
44	Storer, N.P., Babcock, J.M., Schlenz, M., Meade, T.S., Thompson, G.D., Bing, J.W., Huckaba, R.M.	Discovery and characterization of field resistance to Bt maize: <i>Spodoptera frugiperda</i> (Lepidoptera: Noctuidae) in Puerto Rico	Journal of Economic Entomology	2010	Industry study: Dow
45	Storer, N.P., Kubiszak, M.E., King, J.	Status of resistance to Bt maize in <i>Spodoptera frugiperda</i> : Lessons from Puerto Rico	Journal of Invertebrate Pathology	2012	Industry study: Dow
46	Storer, N.P., Thompson, G.D., Head, G.P.	Application of pyramided traits against Lepidoptera in insect resistance management for Bt crops	GM Crops and Food	2012	Industry study: Dow, Monsanto
47	Tan, S.Y., Cayabyab, B.F., Alcantara, E.P., Ibrahim, Y.B., Huang, F., Blankenship, E.E., Siegfried, B.D.	Comparative susceptibility of <i>Ostrinia furnacalis</i> , <i>Ostrinia nubilalis</i> and <i>Diatraea saccharalis</i> (Lepidoptera: Crambidae) to <i>Bacillus thuringiensis</i> Cry1 toxins	Crop Protection	2011	Authors with industry ties: Siegfried; partly funded by industry (Pioneer)
48	Tan, S.Y., Cayabyab, B.F., Alcantara, E.P., Huang, F., He, K., Nickerson, K.W., Siegfried, B. D.	Comparative binding of Cry1Ab and Cry1F <i>Bacillus thuringiensis</i> toxins to brush border membrane proteins from <i>Ostrinia nubilalis</i> , <i>Ostrinia furnacalis</i> and <i>Diatraea saccharalis</i> (Lepidoptera: Crambidae) midgut tissue	Journal of Invertebrate Pathology, 114(3), 234-240.	2013	Authors with industry ties: Siegfried; Industry scientists involved: Tan; supported by Pioneer Hi-Bred International
49	Thompson, G.D., Dalmacio, S.C., Criador, A.R., Alvarez, E.R., Hechanova, R.F.	Field performance of TC1507 transgenic corn hybrids against Asian corn borer in the Philippines	Philippine Agricultural Scientist	2010	Industry study: Dow, Pioneer
50	Tindall, K.V., Siebert, M.W., Leonard, B.R., All, J., Haile, F.J.	Efficacy of Cry1Ac:Cry1F proteins in cotton leaf tissue against fall armyworm, beet armyworm and soybean looper (Lepidoptera: Noctuidae)	Journal of Economic Entomology	2009	Industry scientists involved: Siebert, Haile "The authors gratefully acknowledge the efforts of our many colleagues at Louisiana State University AgCenter, University of Missouri, and Dow AgroSciences."
51	van Kretschmar, J.B., Bailey, W.D., Arellano, C., Thompson, G.D., Sutula, C.L., Roe, R.M.	Feeding disruption tests for monitoring the frequency of larval lepidopteran resistance to Cry1Ac Cry1F and Cry1Ab	Crop Protection	2011	Industry scientists involved: Thompson partly funded by industry: Dow AgroSciences
52	Vélez, A.M., Spencer, T.A., Alves, A.P., Crespo, A.L.B., Siegfried, B.D.	Fitness costs of Cry1F resistance in fall armyworm, <i>Spodoptera frugiperda</i>	Journal of Applied Entomology	2013	Industry scientists involved: Alves, Crespo; authors with industry ties: Siegfried
53	Vélez, A. M., Spencer, T. A., Alves, A. P., Moellenbeck, D., Meagher, R. L., Chirakkal, H., & Siegfried, B. D.	Inheritance of Cry1F resistance, cross-resistance and frequency of resistant alleles in <i>Spodoptera frugiperda</i> (Lepidoptera: Noctuidae)	Bulletin of Entomological Research, 103(06), 700-713.	2013	Industry scientists involved: Alves, Crespo; authors with industry ties: Siegfried; supported by Pioneer and Syngenta
54	Virla, E.G., Alvarez, A., Loto, F., Pera, L.M., Baigori, M.	Fall armyworm strains (Lepidoptera: Noctuidae) in Argentina their associate host plants and response to different mortality factors in laboratory	Florida Entomologist	2008	Partly supported by industry (pesticides)
55	Virla, E.G., Casuso, M., Frias, E.A.	A preliminary study on the effects of a transgenic corn event on the non-target pest <i>Dalbulus maidis</i> (Hemiptera: Cicadellidae)	Crop Protection	2010	Seeds provided by Pioneer
56	Wei, J.Z., Guo, Y.Y., Gao, X.W., Zhang, T., Liang, G.M.	Evaluation of the toxicity of Cry1Fa to the Cry1Ac-resistant cotton bollworm, <i>Helicoverpa armigera</i> (Lepidoptera: Noctuidae)	Acta Entomologica Sinica, 55(10), 1154-1160.	2012	No obvious influence
57	Xu L, Wang Z, Zhang J, He K, Ferry N, Gatehouse AMR	Cross-resistance of Cry1Ab-selected Asian corn borer to other Cry toxins	Journal of Applied Entomology	2010	No obvious influence

	Authors of publication	Title of publication	Journal	Year	Industry influence
58	Yang, F., Qureshi, J.A., Leonard, B.R., Head, G.P., Niu, Y., Huang, F.	Susceptibility of Louisiana and Florida populations of <i>Spodoptera frugiperda</i> (Lepidoptera: Noctuidae) to pyramided Bt corn containing Genuity® VT Double Pro™ and SmartStax™ traits	Florida Entomologist, 96(3), 714-723.	2013	Industry scientists involved: Head; funded by Louisiana Soybean and Feed Grain Promotion Board, Monsanto .
59	Zhang, L., Huang, F., Rogers Leonard, B., Chen, M., Clark, T., Zhu, Y. C., ... & Niu, Y.	Susceptibility of Cry1Ab maize-resistant and-susceptible strains of sugarcane borer (Lepidoptera: Crambidae) to four individual Cry proteins	Journal of Invertebrate Pathology, 112(3), 267-272.	2013	Industry scientists involved: Chen, Clark; partly funded by Louisiana Soybean and Feed Grain Promotion Board, Monsanto

Appendix 4 - Non-target organisms

	Authors of publication	Title of publication	Journal	Year	Industry influence
1	Balog, A., Szenasi, A., Szekeres, D., Palinkas, Z.	Analysis of soil dwelling rove beetles (Coleoptera: Staphylinidae) in cultivated maize fields containing the Bt toxins Cry34/35Ab1 and Cry1F □ Cry34/35Ab1	Biocontrol Science and Technology	2011	No obvious influence
2	Gryspeirt, A., Gregoire, J.C.	Effects of two varieties of <i>Bacillus thuringiensis</i> maize on the biology of <i>Plodia interpunctella</i>	Toxins	2012	Seeds provided by Monsanto and Pioneer
3	Hanley, A.V., Huang, Z.Y., Pett, W. L.	Effects of dietary transgenic Bt corn pollen on larvae of <i>Apis mellifera</i> and <i>Galleria mellonella</i>	Journal of Apicultural Research, 42 (4): 77–81.	2003	No obvious influence
4	Hellmich, R.L., Siegfried, B.D., Sears, M.K., Stanley-Horn, D.E., Daniels, M.J., Mattila, H.R., Spencer, T., Bidne, K.G. Lewis, L.C.	Monarch larvae sensitivity to <i>Bacillus thuringiensis</i> -purified proteins and pollen	Proceedings of the National Academy of Sciences, 98(21): 11925-11930.	2001	Authors with industry ties: Hellmich, Siegfried Study partly funded by industry (Agricultural Biotechnology Stewardship Technical Committee)
5	Kim, Y.H., Hwang, C.E., Kim, T.S., Lee, J.H., Lee, S.	Assessment of potential impacts due to unintentionally released Bt maize plants on non-target aphid <i>Rhopalosiphum padi</i> (Hemiptera: Aphididae)	Journal of Asia-Pacific Entomology	2012	No obvious influence
6	Li, Y.H., Romeis, J., Wu, K. M., Peng, Y.F.	Tier-1 assays for assessing the toxicity of insecticidal proteins produced by genetically engineered plants to non-target arthropods.	Insect science	2013	Author with industry ties: Romeis
7	Mason, C.E., Sheldon, J.K., Pesek, J., Bacon, H., Gallusser, R., Radke, G., Slabaugh, B.	Assessment of <i>Chrysoperla plorabunda</i> longevity fecundity and egg viability when adults are fed transgenic Bt corn pollen	Journal of Agricultural and Urban Entomology	2008	No obvious influence
8	Perry, J.N., Devos, Y., Arpaia, S., Bartsch, D., Ehlert, C., Gathmann, A., Hails, R.S., Hendriksen, N.B., Kiss, J., Messean, A., Mestdagh, S., Neemann, G., Nuti, M., Sweet, J.B., Tebbe, C.C.	Estimating the effects of Cry1F Bt-maize pollen on non-target Lepidoptera using a mathematical model of exposure many of the authors are former or recent members of the GMO expert panel of EFSA	Journal of Applied Ecology	2012	Authors with industry ties: Bartsch, Sweet, Kiss,...
9	Prihoda, K.R., Coats, J.R.	Examination of the fate of Bt Cry1F protein in an aerobic aquatic system	Abstracts of Papers of The American Chemical Society	2006	No information about funding available Conference abstract (grey literature)

	Authors of publication	Title of publication	Journal	Year	Industry influence
10	Sears, M.K., Hellmich, R.L., Stanley-Horn, D.E., Oberhauser, K.S., Pleasants, J.M., Mattila, H.R., Siegfried, B.D., Dively, G.P.	Impact of Bt corn pollen on monarch butterfly populations: a risk assessment	Proceedings of the National Academy of Sciences, 98(21), 11937-11942.	2001	Authors with industry ties: Sears, Hellmich, Dively
11	Tian, J.C., Long, L.P., Wang, X.P., Naranjo, S.E., Romeis, J., Hellmich, R.L., Wang, P., Shelton, A.M.	Using Resistant Prey Demonstrates That Bt Plants Producing Cry1Ac, Cry2Ab, and Cry1F Have No Negative Effects on <i>Geocoris punctipes</i> and <i>Orius insidiosus</i>	Environmental entomology, 43(1), 242-251.	2014	Authors with industry ties: Romeis, Hellmich, Shelton
12	Tian, J.C., Wang, X.P., Long, L.P., Romeis, J., Naranjo, S.E., Hellmich, R.L., Shelton, A.M.	Eliminating host-mediated effects demonstrates Bt maize producing Cry1F has no adverse effects on the parasitoid <i>Cotesia marginiventris</i>	Transgenic research, 1-8.	2013	Authors with industry ties: Romeis, Hellmich, Shelton
13	Tian, J.C., Collins, H.L., Romeis, J., Naranjo, S.E., Hellmich, R.L., Shelton, A.M.	Using field-evolved resistance to Cry1F maize in a lepidopteran pest to demonstrate no adverse effects of Cry1F on one of its major predators	Transgenic Research	2012	Authors with industry ties: Romeis, Hellmich, Shelton
14	Tian, J.C., Wang, X.P., Long, L.P., Romeis, J., Naranjo, S.E., Hellmich, R.L., Wang, P., Earle, E.P., Shelton, A.M.	Bt crops producing Cry1Ac, Cry2Ab and Cry1F do not harm the green lacewing, <i>Chrysoperla rufilabris</i>	PloS one, 8(3), e60125.	2013	Authors with industry ties: Romeis, Hellmich, Shelton
15	Wolt, J.D.	A mixture toxicity approach for environmental risk assessment of multiple insect resistance genes	Environmental Toxicology and Chemistry	2011	Author with industry ties : Wolt (former Dow)
16	Wolt, J.D., Hellmich, R.L., Prasifka, J.R., Sears, M.K.	Global regulatory perspectives regarding transgenic crop risks to nontarget insects: the case of Cry1F maize and butterflies	Bulletin OILB/SROP	2006	Author with industry ties: Wolt, Hellmich, Sears Switched to industry: Prasifka
17	Wolt, J.D., Conlan, C.A., Majima, K.	An ecological risk assessment of Cry1F maize pollen impact to pale grass blue butterfly	Environmental Biosafety Research	2005	Author with industry ties: Wolt
18	Zhang, X., Li, Y., Romeis, J., Yin, X., Wu, K., & Peng, Y.	Use of a Pollen-Based Diet to Expose the Ladybird Beetle <i>Propylea japonica</i> to Insecticidal Proteins	PloS one, 9(1), e85395.	2014	Author with industry ties: Romeis

Appendix 5 - Soil / Microorganisms

Authors of publication	Title of publication	Journal	Year	Industry influence
Blackwood, C.B. & Buyer, J.S.	Soil microbial communities associated with Bt and non-Bt Corn in three soils	Journal of Environmental Quality, 33, 832-836	2004	No obvious influence
Cheeke, T.E., Cruzan, M.B., Rosenstiel, T.N.	Field evaluation of arbuscular mycorrhizal fungal colonization in <i>Bacillus thuringiensis</i> toxin-expressing (Bt) and non-Bt maize	Applied and environmental microbiology, 79(13), 4078-4086.	2013	Supported by industry "Feedback from Monsanto Co. and an additional seed industry seed supplier. Maize seed for this research was provided by Syngenta Seeds Inc. (Boise, ID, USA), Monsanto Company (St. Louis, MO, USA), and an additional seed industry seed supplier."

Cheeke T.E., Rosenstiel T.N., Cruzan, M.B.	Evidence of reduced arbuscular mycorrhizal fungal colonization in multiple lines of Bt maize	American Journal of Botany	2012	Supported by industry "Maize seed was provided by Syngenta Seeds, Monsanto Co., and an additional seed industry representative"
Cotta, S.R., Dias, A.C.F., Marriel, I.E., Gomes, E.A., van Elsas, J.D., Seldin, L.	Temporal dynamics of microbial communities in the rhizosphere of two genetically modified (GM) maize hybrids in tropical agrosystems	Antonie van Leeuwenhoek, 103(3), 589-601.	2013	Industry influence unclear
Herman, R.A., Wolt, J.D., Halliday, W.R.	Rapid degradation of the Cry1F insecticidal crystal protein in soil	Journal of agricultural and food chemistry, 50(24), 7076-7078.	2002	Industry study
Higgins, L.S., Babcock, J., Neese, P., Layton, R.J., Moellenbeck, D.J., Storer, N.	Three-year field monitoring of Cry1F, event DAS-1507-1, maize hybrids for nontarget arthropod effects	Environmental Entomology	2009	Industry study
Shan, G., Embrey, S.K., Herman, R.A., McCormick, R.	Cry1F protein not detected in soil after three years of transgenic Bt corn (1507 corn) use	Environmental Entomology	2008	Industry study

Appendix 6 - Industry ties of publicly funded scientists involved in risk assessment of 1507

1. Eric C. Burkness

Position:

Senior Research Fellow at University of Minnesota, Department of Entomology¹⁵

Number of studies with maize 1507 / Cry1F maize: 2

Industry ties:

- Studies with (partly) industry funding (Burkness et al., 2010)
- Co-author of studies with scientists with industry ties (for example Shelton et al., 2013; Dutra et al. 2012, Burkness et al., 2011; Hutchison et al., 2010;)

2. Galen P. Dively

Position:

Professor Emeritus and IPM Consultant, University of Maryland¹⁶

¹⁵ http://experts.umn.edu/expert.asp?n=Eric+C+Burkness&u_id=5790&oe_id=1&o_id=117

¹⁶ <http://entomology.umd.edu/directory/galenpdively>

Number of studies with maize 1507 / Cry1F maize: 1

Industry ties:

- Co-author of papers with industry scientists (Naranjo et al., 2005; Storer et al., 2008; Duan et al., 2008)
- Co-author of several (3 of 4) of the 2001 industry-sponsored studies on Monarch butterfly and Bt maize¹⁷
- Other Studies with industry funding (Dively, 2005)
- Co-author of studies with scientists with industry ties (Shelton et al., 2009a,b; Ortman et al., 2001)
- Co-authored several papers with clear pro-industry stance (Shelton et al., 2009a,b; Ortman et al., 2001)

3. Richard L. Hellmich

Position:

Iowa State University (like Wolt), USDA Research Entomologist, USDA-ARS, Corn Insects and Crop Genetics Research Unit¹⁸

Number of studies with maize 1507 / Cry1F maize: 12

Industry ties:

- Co-author of several ILSI publications (Carstens et al., 2013; Huesing et al, 2008; Romeis et al., 2008)
- Member of a Monsanto Advisory Committee (Corn Rootworm Knowledge Research Program), along with Aaron Gassmann, Michael Gray, and Blair D. Siegfried¹⁹
- Contributor to a book edited by Bruce Hammond (Monsanto), „Food Safety of Proteins in Agricultural Biotechnology“ along with Jeffrey Wolt, and Stephan Vieths²⁰
- Coordinator of the 2001 industry-sponsored studies on Monarch butterfly and Bt maize and co-author of several of these studies (see footnote 1), see also Hart, 2003.²¹

¹⁷ Sears et al., 2001; Hellmich et al., 2001; Stanley-Horn et al., 2001; Pleasants et al. 2001; Oberhauser et al., 2001

¹⁸ <http://www.ent.iastate.edu/dept/faculty/hellmich.html>

¹⁹ <http://www.monsanto.com/crwknowledge/pages/advisory-committee.aspx>

²⁰ http://books.google.de/books?id=44P3k7-yZz4C&printsec=frontcover&hl=de&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

²¹ Kathleen Hart. (2003). Eating in the Dark: America's Experiment with Genetically Engineered Food. Random House of Canada. http://books.google.de/books?id=1b_DeupXuGIC&printsec=frontcover&hl=de&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

- Funding by Monsanto (1999)²²
- Papers with industry scientists from Monsanto, Syngenta, Pioneer (Carstens et al., 2013; Huesing et al., 2011; Romeis et al., 2011; Wolt et al., 2010; Gealy et al., 2007)

4. William D. Hutchison

Position:

Professor of Entomology, University of Minnesota²³

Number of studies with maize 1507 / Cry1F maize: 3

Industry ties:

- Grants by Syngenta, Monsanto, Pioneer²⁴
- Member of Editorial Board of GM Crops & Food journal, along with many well-known pro-GMO and industry scientists²⁵
- Publications with scientists with industry ties such as Dively, Shelton, Romeis (Shelton et al., 2013; Dutra et al., 2012;
- Studies funded by industry (Burkness et al., 2010)
- Studies with industry scientists (Hutchison et al., 2011)

5. Jörg Romeis

Position:

Agroscope, Institute for Sustainability Sciences ISS²⁶

Number of studies with maize 1507 / Cry1F maize: 6

Industry ties:

- Co-author of ILSI publications, (Romeis et al., 2011)
- Organiser of ILSI workshops²⁷

²² <http://ageconsearch.umn.edu/bitstream/21606/1/sp99hu04.pdf>

²³ <http://www.entomology.umn.edu/People/GradFaculty/Hutchison/>

²⁴ http://experts.umn.edu/expertGrants.asp?n=William+D+Hutchison&u_id=1228&oe_id=1&o_id=81

²⁵ <http://www.landesbioscience.com/journals/gmcrops/editorialboard/>

²⁶ <http://www.agroscope.admin.ch/org/mitarbeitersuche/mitarbeiterprofil/index.html?lang=en&mid=519>

²⁷ CERA (2012) Surrogate Species Selection for Assessing Potential Adverse Environmental Impacts of Genetically Engineered Plants on Non-Target Organisms, Conference Proceedings, June 26 - 28, 2012. http://cera-gmc.org/docs/cera_publications/pub_03_2010.pdf

- Publications with scientists with industry ties (Romeis et al., 2008; Romeis et al., 2011; Carstens et al., 2013; Dutra et al., 2012; Huesing et al., 2011; Shelton et al., 2009a,b;
- Studies with industry scientists (Romeis et al., 2008; Romeis et al., 2011; Carstens et al., 2013; Huesing et al., 2011)
- Member of PRRI, a pro-GM lobby group founded by Klaus Ammann. PRRI was sponsored by Syngenta Foundation, CropLife International, US Grain Council, Monsanto and Arborgen^{28 29}
- ISBR, (former?) member of ISBR Publications Committee comprising Tom Nickson (Monsanto), Alan Raybould (Syngenta), Jörg Romeis and Patrick Rudelsheim³⁰. ISBR has close ties with the GMO industry. ISBR conferences are regularly sponsored by companies such as Monsanto, Bayer, Dow AgroSciences, DuPont, Syngenta and by industry groups such as CropLife International.³¹
- Former convenor of GMO working group of the International Organization for Biological and Integrated Control of Noxious Animals and Plants, West Palearctic Regional Section (IOBC/WPRS)^{32 33}; members comprise industry scientists and ones with ties to industry

6. Mark K. Sears

Position:

Adjunct Professor, Environmental Biology, University of Guelph³⁴

Number of studies with maize 1507 / Cry1F maize: 2

Industry ties:

- formed the Canadian Corn Pest Coalition, a group consisting of growers, Provincial extension personnel, publically-funded researchers from Agriculture and Agri-Food Canada and the University of Guelph, and seed industry representatives³⁵. Members include Bayer

²⁸ <http://www.ppri.net/ppri-members/>

²⁹ http://web.archive.org/web/20090709062104/http://pubresreg.org/index.php?option=com_content&task=view&id=12&Itemid=29

³⁰ <http://web.archive.org/web/20130530142244/http://www.isbr.info/?q=node/9>

³¹ <http://www.isbgmo.com/conference-sponsors.html>

³² http://www.iobc-wprs.org/expert_groups/18_wg_gmo.html

³³ https://web.archive.org/web/20130705145159/http://www.iobc-wprs.org/expert_groups/18_wg_gmo.html

³⁴ http://www.envbio.uoguelph.ca/f_sears.shtml

³⁵ <http://www.epa.gov/scipoly/sap/meetings/2013/december/120413biosketch.pdf>

CropScience Canada, Cargill AgHorizons, CropLife Canada, Dow AgroSciences Canada, Monsanto Canada Inc., Pioneer Hi-Bred Limited, Syngenta Seeds Canada Inc.³⁶

- Publications with scientists with industry ties (Dively et al. 2004; Hellmich et al., 2001; Oberhauser et al., 2001; Ortman et al., 2001; Pleasants et al., 2001; .Shelton et al., 2009a,b; ..)
- Studies with industry scientists (Romeis et al, 2008;Wolt et al., 2010)
- Co-author of ILSI publication: Wolt et al., 2010

7. Anthony Shelton

Position:

Professor, Cornell University, Department of Entomology³⁷

Number of studies with maize 1507 / Cry1F maize: 4

Industry ties:

- Publications with scientists with industry ties: Ortman et al., 2001; Shelton et al., 2009a,b; Shelton et al., 2013
- Studies with industry scientists: Romeis et al, 2008, 2011
- Consultant, Agricultural Biotechnology Stewardship Committee (Dow, Monsanto, DuPont, Syngenta), 1998-2002³⁸

8. Blair D. Siegfried

Position:

Charles Bessey Professor of Entomology, University of Nebraska-Lincoln³⁹

Number of studies with maize 1507 / Cry1F maize: 15

Industry ties:

- Member of a Monsanto Advisory Committee (Corn Rootworm Knowledge Research Program), along with Aaron Gassmann, Michael Gray, and Richard Hellmich⁴⁰

³⁶ <http://www.compest.ca/index.cfm/contacts/partners/>

³⁷ <http://shelton.entomology.cornell.edu/people/tony-shelton/>

³⁸ <http://files.campus.edublogs.org/blogs.cornell.edu/dist/2/2140/files/2012/04/AMS-CV-ww50qb.pdf>

³⁹ <http://entomology.unl.edu/faculty/siegfried.shtml>

⁴⁰ <http://www.monsanto.com/crwknowledge/pages/advisory-committee.aspx>

- Studies with industry scientists: Siegfried et al., 2013,
- Publications with scientists with industry ties: Hellmich et al., 2001; Ortman et al., 2001; Sears et al., 2001
- International Life Sciences (ILSI). Expert Panel Evaluation of Insect Resistance Management in Bt Field Corn: A Science-Based Framework for Risk Assessment and Risk Management, 1997 - 1998⁴¹

Inventor of patents:

- dsRNA Delivery Composition and Methods of Use (filed 2011)⁴²
- “Combinations of Cry1Ab and Cry1Fa as an insect resistance management tool” (patents held by Dow, filed 2005 and 2008)⁴³

9. Jeffrey D. Wolt

Position:

Biosafety Institute for Genetically Modified Agricultural Products (BIGMAP), Iowa State University

<http://www.bigmap.iastate.edu/publications/wolt.html>

Number of studies with maize 1507 / Cry1F maize: 4

Industry ties:

- Wolt is a former employee of Dow AgroSciences from about 1990⁴⁴ to 2003⁴⁵
- Publications with scientists with industry ties: Shelton et al., 2009a,b; ...
- Studies with industry scientists: Wolt et al., 2010; Herman et al., 2002; Gealy et al., 2007; Huesing et al., 2011; Shan et al., 2005; Romeis et al., 2008; ...
- Co-author of ILSI publication: Wolt et al., 2010

⁴¹ <http://entomology.unl.edu/faculty/siegfried.shtml>

⁴² <https://www.google.de/patents/US20110268691?dq=blair+siegfried&hl=de&sa=X&ei=LBI0U6e2HIXasgaXjYDQCQ&ved=0CEsQ6AEwAQ>

⁴³ https://www.google.de/patents/US20070006340?dq=ininventor:blair+ininventor:siegfried&hl=en&sa=X&ei=2xIOU9G_N8jGtAbciICoAQ&ved=0CE0Q6AEwAw
https://www.google.de/patents/US20080311096?dq=ininventor:blair+ininventor:siegfried&hl=en&sa=X&ei=2xIOU9G_N8jGtAbciICoAQ&ved=0CEYQ6AEwAg

⁴⁴ <http://www.jstor.org/discover/10.2307/3986773?uid=3737864&uid=2&uid=4&sid=21103456584341>

⁴⁵ <http://www.bioone.org/doi/abs/10.1603/0046-225X-32.2.237?journalCode=enve>