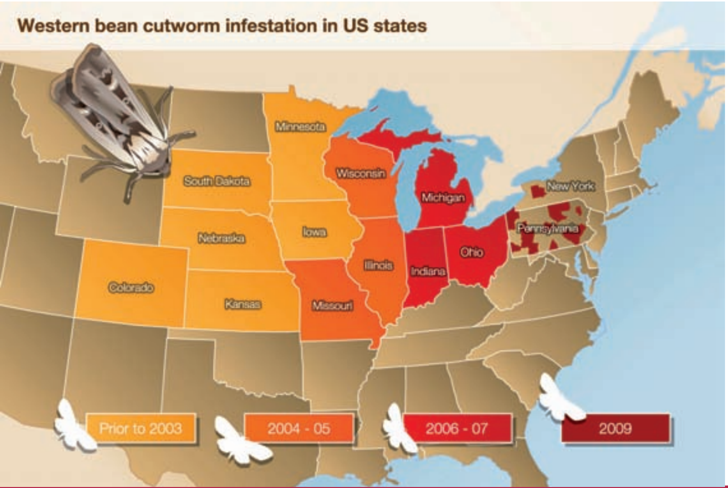
Testbiotech
Institute for Independent
Impact Assessment in
Biotechnology



Agro-Biotechnology:
New plant pest caused by genetically engineered corn

The spread of the western bean cutworm causes massive damage in the US

Testbiotech Report March 2010, prepared for Greenpeace Germany

Author: Christoph Then
Cooperation: Lars Neumeister, Andreas Bauer
Editing: Andrea Reiche

New plant pest caused by genetically engineered corn

The spred of the western bean cutworm causes massive damage in the US

A Testbiotech Report prepared for Greenpeace Germany

Imprint
Testbiotech e.V.
Frohschammerstr. 14
80807 München
Tel.: +49 (0) 89 358 992 76
Fax: +49 (0) 89 359 66 22
info@testbiotech.org
www.testbiotech.org

Executive Director: Dr. Christoph Then

Date of Publication
March 2010

Content

Summary

In the US genetically engineered corn plants expressing the Bt toxin classified as Cry1Ab are being infested by the larvae of the western bean cutworm (Striacosta albicosta). The infestation has been observed since the year 2000 and the western bean cutworm is emerging as a new plant pest. This cutworm has historically been confined to very limited regions and did not cause any major problems in maize crops. For several years now the pest has been spreading into more and more regions within the US Corn Belt and causing substantial economic damage. In 2009, maize plants affected by the western bean cutworm were even found in Canada for the first time.

According to scientific publications, this new pest has been caused by the large-scale cultivation of genetically engineered plants expressing Cry1Ab such as MON810. It is seen as a case of 'pest replacement', often found where there is extensive use of pesticides in industrial agriculture. Pest replacement means that new ecological niches open up which other competitors then occupy. In this case, a naturally occurring competitor of the western bean cutworm has been intentionally suppressed by the extensive cultivation of Bt maize plants, thus allowing the new pest to spread on a large scale and heavily infest the crop. A whole arsenal of insecticides - some of them highly toxic - and genetically engineered multi-stacked maize are recommended for controlling the pest. These so-called solutions such as “Herculex”[1] or “SmartStax” can however substantially add to the problem or cause even new ecological risks.

1 The brandname ‘Herculex’ covers several corn seed variations, some of them producing more than one Bt toxin, http://www.dowagro.com/herculex/

Genetically engineered corn exposes Bt toxin in a new way

Genetically engineered plants (mainly corn/maize and cotton) producing Bt toxins are grown worldwide on millions acres of farmland. One of the largest areas growing genetically engineered Bt corn is in the USA where more than 70 million acres were planted in 2008 (Hubbard, 2009).

Bt toxins are part of a group of several hundred toxins which occur naturally with certain bacteria in the soil (Bacillus thuringiensis) (Schnepf et al., 1998). These Bt toxins are used in sprays as an environmentally friendly insecticide. In comparison to Bt toxins which occur naturally, those produced in genetically engineered plants are partially changed in their structure and toxicity (Hilbeck 2006; Li, 2007). In addition, these toxins are present throughout the whole vegetation period (and can be found in the soil even after harvesting).

The genetically engineered corn MON810 is grown in some EU member states but its authorisation is currently subject to reassessment. At the same time, two other genetically engineered traits expressing Bt are in the process of being authorised. These are Syngenta's Bt 11 and Pioneer Hi-Bred's maize 1507. MON810, which is sold under the brand name 'YieldGard', produces a Bt toxin classified as Cry1Ab, as does Bt 11 maize 1507 marketed by Pioneer Hi-Bred and Dow AgroSciences. Bt 11 maize is sold under the brand name 'Herculex' and produces another Bt toxin classified as Cry1F which targets a slightly different range of insect pests. These two toxins are also active in a corn hybrid called 'SmartStax' which contains six different Bt toxins overall.

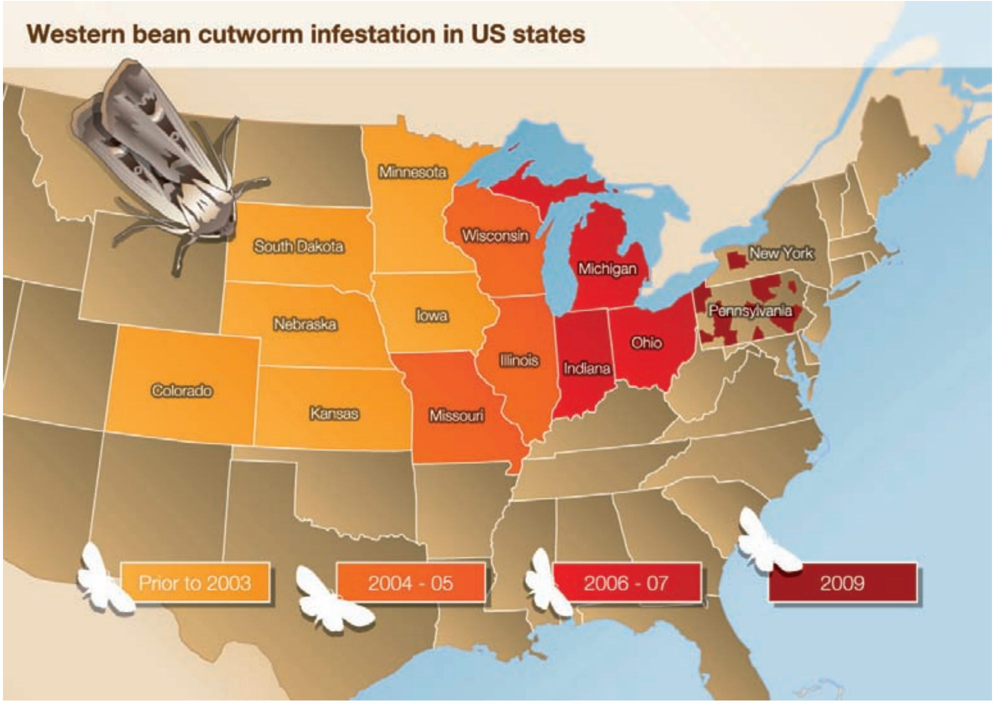
New pest spreads

Since around the year 2000 it has become apparent that genetically engineered corn expressing the Bt toxin classified as Cry1Ab is being infested by western bean cutworm (Striacosta albicosta) (Rice, 2000, O'Rourke&Hutchison, 2000). The western bean cutworm was historically only found in some regions and caused few problems. At present, it is spreading into more and more US states and causing significant economic damage. In 2006, a scientific publication reported extensive damage in South Dakota (Catangui&Berg 2006). By 2004, there were similar reports from Iowa, Illinois and Missouri (Dorhout&Rice, 2004). In the meantime, western bean cutworm damage has been documented for almost all states in the American Corn Belt. States affected include Iowa, Missouri, Minnesota, Wisconsin, Indiana, Michigan and Ohio (Eichenseer et al., 2008). Historically damage caused by the western bean cutworm was mainly confined to Nebraska with very low incidences in some other regions. In 2009, the new pest showed an unbroken tendency to geographical expansion and was found for the first time in Canada[2].

One of the very few reports so far available in Europe explains that:

„The most damaging pest of corn cultivation in the US, the European corn borer, now has a competitor: The western bean cutworm, so far only known as pest in dry beans is on its way to become number one in the US Corn Belt, as expert in insects predict."[3]

Fig 1: Western Bean Cutworm infestation 2000-2009[4]



According to several studies (Rice, 2000; O'Rourke&Hutchinson, 2000; Catangui&Berg, 2006) genetically engineered plants expressing Cry1Ab were affected much more than conventional plants.

2 http://corn.osu.edu/story.php?setissueID=310&storyID=1901
3 http://www.profil.iva.de/html/text.php?id=518; Industrieverband Agrar e. V. (IVA) 2008, published on 29.9.2006, online no longer available
4 Source: http://www.croplangenetics.com/FINDSEED/CORN/ECMD014102.aspx, http://www.omafra.gov.on.ca/english/crops/field/news/croppest/2009/18cpo09a3.htm

Genetically engineered corn as the cause

There are several studies which explain more precisely how the spread of the western bean cutworm is furthered in particular by growing genetically engineered corn. Accordingly, it is a process of "pest replacement". This is a phenomena previously observed in intensive agriculture, where there is a massive use of pesticides. Pest replacement opens up new ecological niches in which other competitors (pests) can thrive.

In this instance, the genetically engineered corn and the western bean cutworm are part of a complicated story involving three factors. Cry1Ab expressed by the genetically engineered corn is not only active against the European corn borer but also active against the corn earworm (Helicoverpa zea[5]). This latter pest feeds not only on corn but is also cannibalistic to other pest insects such as the western bean cutworm (Rice, 2006).

Suppression of the corn earworm meant that the western bean cutworm lost its natural competitor and has ever since been able to spread unchecked. Rice &Dorhout (2006) investigated the competition between the corn earworm and the western bean cutworm:

„In our competition studies, the data indicate that western bean cutworm survival was very low when they encounter a corn earworm of equal or greater size. The corn earworm is an aggressive insect that will kill the western bean cutworm if possible." (Rice&Dorhout, 2006)

The corn earworm is sensitive to the Bt toxin Cry1Ab, but the western bean cutworm is not, so that the equilibrium between the two insect pests changes when the transgenic corn, known in the USA mainly under the brand name of YieldGard, is grown extensively. So far, this is the most plausible scientific explanation of why in recent years the western bean cutworm was able to spread so extensively and develop into a new corn pest:

„When the western bean cutworm and the corn earworm occur in the same environment, competition exists. The corn earworm is the better competitor, often killing the western bean cutworm, except when the western bean cutworm is substantially larger than the corn earworm. Transgenic corn, such as the YieldGard hybrid, may influence the competitive success of these two

5 This is also a cotton crop pest and known as cotton bollworms

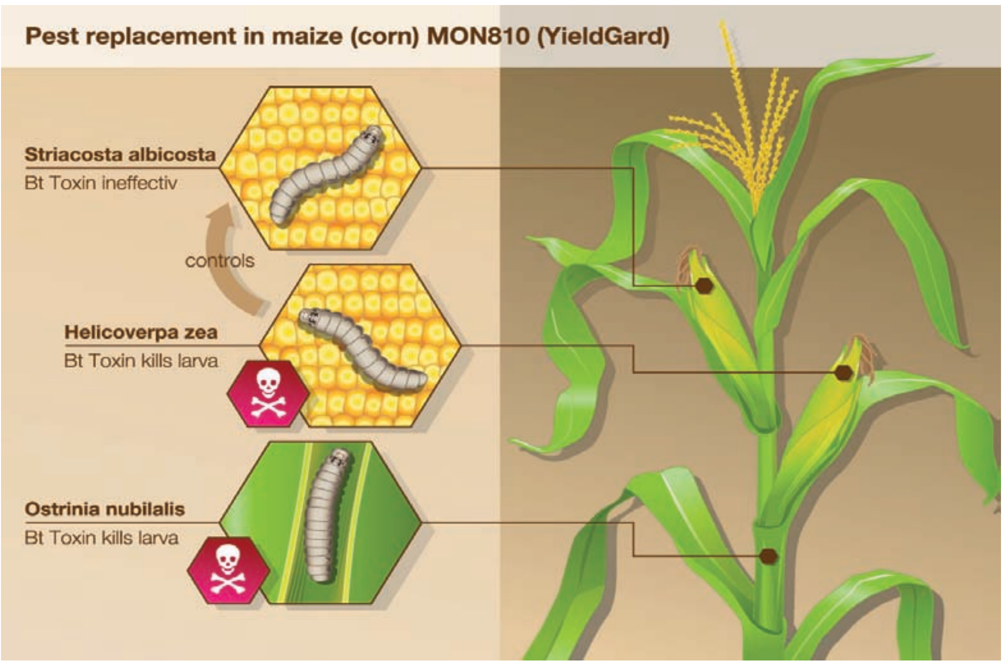
species. Lastly, when YieldGard suppresses corn earworm populations, this may allow western bean cutworms to become the more damaging pest and also allow it to expand its geographical range" (Rice&Dorhout, 2006).

Pioneer Hi-Bred, a company which also sells genetically engineered Bt corn, agrees with this interpretation. In an article in the company's own journal, its staff member Steven Butzen writes:

„These studies suggest that by removing certain damaging species, the hybrids with the YGCB [YieldGard] trait created a "void" for a new insect species to thrive. In these studies, the damage from the new insect on hybrids with the YGCB trait was worse than damage from the old insect species on the non-transgenic hybrid. This phenomenon of "pest replacement" may help explain the recent, rapid range expansion of WBC across the Corn Belt from Nebraska to Ohio." (Butzen et al., 2007)

Interaction between the western bean cutworm and the corn earworm was confirmed in 2010 (Dorhout&Rice, 2010). It can without doubt be concluded that the spread of the western bean cutworm is in fact fostered by the cultivation of Bt corn MON810.

Fig. 2: Pest replacement in Bt Maize producing Cry1Ab (known as MON810, YieldGard)



Massive damage

Damage caused by the western bean cutworm can be more extensive than that caused by the European corn borer in conventional plants (Catangui&Berg, 2006). The larvae often infest the tip of the corncob, but also other places on the cob (see Fig. 3). Dow AgroSciences warned that up to 50 percent of the harvest could be affected[6]. Experts from Nebraska describe damage that could affect up to 60 percent of corncobs[7]. Other authors estimate maximum damage at 30 to 40 percent[8]. In many cases, the actual damage is below these figures because there are often some growing seasons between the first appearance of the pest and serious economic damage. It is widely expected that there will be a further increase in damage over the coming years. Not only can the regional expansion of the pest increase but also the intensity of the damage it causes[9].

Industry's solution: More genetically engineered corn

What happened came as a surprise to farmers who are only now being told by seed and agricultural chemical companies how to recognise and control western bean cutworm infestation. For the companies themselves however this development is probably not unknown. After all, the scenario observed at present had already been predicted in 1997 (Ostlie et al., 1997):

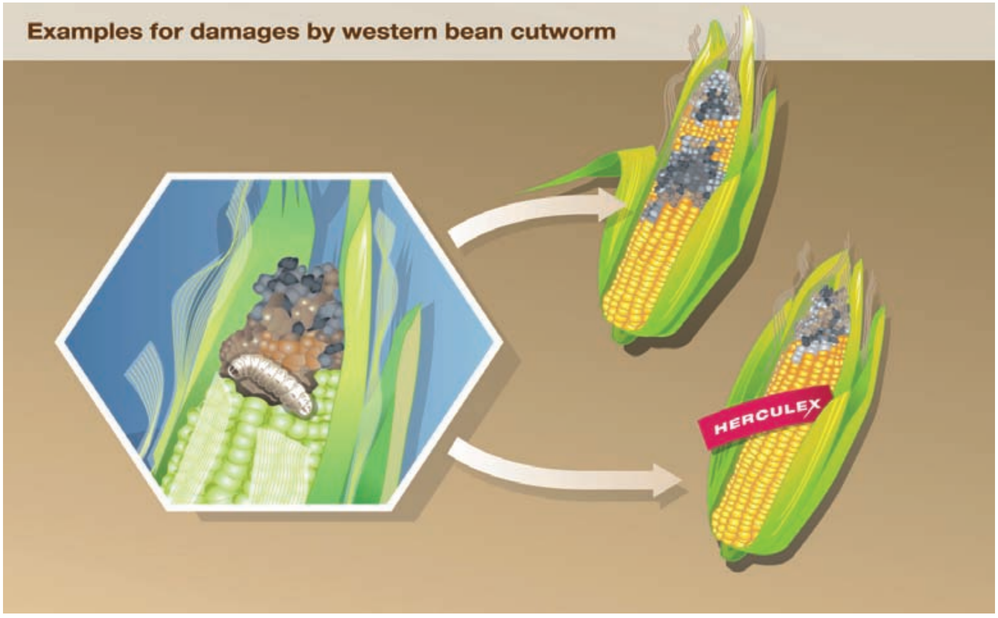
"Minor pests such as the western bean cutworm could become a new threat if the Bt toxin had no activity against this pest and it was not decimated by its natural enemies."

Actually, the companies had a possible solution in readiness: Pioneer Hi-Bred and Dow AgroSciences have already started to market a further corn hybrid in the USA, so-called 'Herculex' Corn, which expresses another variant of the Bt toxin (Cry1F), meant to be effective against western bean cutworm larvae.

6 This is also a cotton crop pest and known as cotton bollworms
7 http://elkhorn.unl.edu/epublic/pages/publicationD.jsp?publicationId=344
8 http://www.agriview.com/articles/2008/08/01/crop_news/crops03.txt
http://www.extension.org/pages/Western_Bean_Cutworm_Gaining_Foothold_in_Ohio
9 http://corn.osu.edu/story.php?setissueID=310&storyID=1901
http://ontariofarmer-productionblog.blogspot.com/2009/10/get-ready-for-western-bean-cut worm-next.html
http://bautebugblog.com/more-western-bean-cutworm-damage-being-found/

Genetically engineered corn producing Cry1F has been grown commercially in the US since 2001. Scientists close to industry have long since started field trials and published their findings. These show that growing the new corn hybrid could be the solution to the problem (Eichenseer et al., 2008). There is however another problem here: Western bean cutworm infestation can be curbed by growing the new corn hybrid, but not completely prevented. Presumably, western bean cutworm larvae have differing levels of sensitivity. In 2009, there were already reports of damage caused by the western bean cutworm in plants expressing Cry1F[10].

Fig. 3 Examples for damages caused by the western bean cutworm to corn with and without expressing Cry1F[11]



Growing Herculex could mean that less sensitive larvae were systematically selected and then able to spread rapidly throughout the population. In reality, the apparent solution to the problem could aggravate the situation because the western bean cutworm population may develop an extensive resistance to Cry1F. Even though companies know that Herculex is only 80 to 90 percent

10 http://www.omafra.gov.on.ca/english/crops/field/news/croppest/2009/19cpo09a2.htm
11 One of the sources: http://www.omafra.gov.on.ca/english/crops/field/news/croppest/2009/19cpo09a2.htm

effective against western bean cutworm (Eichenseer et al., 2008) they nevertheless recommend it to stop the larvae from spreading[12]. In 2003 when the first reports on the spread of the western bean cutworm appeared, the companies concerned, Pioneer and Dow AgroSciences, were probably getting out the champagne. David Borgmeier at Dow AgroSciences, is quoted as saying:

„Western bean cutworm is becoming a significant pest in the Corn Belt, and we're excited to bring farmers a more effective option against it."[13]

There is no mention that the problem might be considerably curbed if US farmers were to stop growing corn expressing Cry1Ab (such as YieldGard, MON810 or Bt 11 varieties). This may have to do with liability issues. The fact that Cry1Ab corn has substantially increased corn damage from a previously minor corn pest might raise questions if the companies selling this corn could be made liable for the damage. When it became clear to Pioneer that there was a direct connection between growing specific hybrids of Bt corn and the spread of the new pest (Butzen & Dorhout, 2007), the company should have informed US farmers that they could help to prevent or curb the spread of the new pest by no longer growing these variants of transgenic corn. However, there was never a clear warning about growing these genetically engineered corn hybrids. It is not only the corn growers who are affected by this development. As a publication (full content not available for general public, DiFonzo&Hamond, 2008) explains, the increased population also endangers production of edible beans in one of the most relevant regions:

„This report documents the capture of adults in Michigan and Ohio, extending the eastern range of western bean cutworm. In addition to the risk of economic damage to corn in both states, there is now potential for severe damage to edible beans, as Michigan ranks second in United States dry bean production."

Indeed, in some regions of Michigan, farmers were advised to spray insecticides to avoid damage in dry bean cultivation.[14]

12 http://www.dowagro.com/herculex/news/20070619b.htm
13 http://www.highbeam.com/doc/1G1-107761744.htm
14 http://www.omafra.gov.on.ca/english/crops/field/news/croppest/2009/18cpo09a3.htm

Instead of informing the farmers about the possible impact of large scale growing of genetically engineered corn, companies are pushing for the development of the armament of genetically engineered corn. In 2009, it was expected that around 75 percent of all genetically engineered corn varieties would have been genetically engineered at least three times (so-called triple stack) and contain several variants of the Bt toxin.[15] Additionally in 2009, the USA and Canada licensed a genetically engineered corn hybrid with eight gene constructs incorporating six different Bt toxins called 'SmartStax'. It is meant to be active against the western bean cutworm and to prevent the emergence of new pests in corn growing.[16] In relation to the spread of the western bean cutworm in all these multi-stacked plants like SmartStax the active ingredient is Cry1F – thus they all have the same deficiency as the 'Herculex' plants: They can control the western bean cutworm only to an extent around 80 or 90 percent. In addition, those plants also produce Cry1Ab thereby suppressing the natural competitor of the western bean cutworm.

The US insect resistance management (IRM) implies a high dose and refuge strategy[17]: The dosage of the Bt toxin within the plants has to be high enough to kill the pest insects by more or less 100 percent. Refuge zones are areas in or near the Bt crop that are planted with non-Bt corn. If resistant insects emerge from the Bt crop they can mate in refuge zones with non resistant insects and thereby dilute any genetic disposition to resistance. The aim of this strategy is to reduce the risk of resistance developing in the long term. Apparently, the risk of insect pests developing resistance is high. Tabashnik et al. (2009) just recently published some alarming examples of emerging Bt resistant strains in several regions. Amongst others he noticed field resistance of Spodoptera frugiperda to Bt corn producing Cry1F occurring in Puerto Rico being the fastest documented case of field-evolved resistance to a Bt crop. This caused withdrawal of the Bt crop from the marketplace.

The current high dose and refuge strategy has major limitations. These are becoming evident where the western bean cutworm is spreading. Cry1F in plants

15 http://www.dtnprogressivefarmer.com/dtnag/common/link.do?symbolicName=/ag/blogs/template1&blogHandle=business&blogEntryId=8a82c0bc1ae0f224011ae9296a9e005f
16 www.epa.gov/oppbppd1/biopesticides/pips/smartstax-factsheet.pdf
17 http://www.epa.gov/pesticides/biopesticides/regtools/biotech-reg-prod.htm

such as 'Herculex' or 'SmartStax' does not seem to fulfil the requirements of high dose management because it only kills about 80 or 90 percent of the pest insects. There are some good reasons for arguing that the cultivation of crops such as Herculex or SmartStax is not in line with the general regulations of the EPA. The cultivation of plants with this combination of toxins should be causing deep concerns. Farmers are being advised to grow corn varieties that might create pest insects that are more resistant to Bt toxins and thereby foster pest replacement. Instead of pointing out the possible consequences of growing genetically engineered corn, companies are simply seeking to follow their business concepts by marketing new products.

There is an ongoing struggle in the fields between pest insects and the weaponry of genetically engineered plants – it is a struggle with an uncertain outcome. Michael Catangui, who in 2006 drew attention to this problem in one of the few scientific publications (Catangui&Berg, 2006) warned against relying on Bt technologies.

„Current Bt products are very powerful, but when you get rid of one pest, there are other secondary pests that suddenly find a whole new field to themselves.”[18]

18 http://cornandsoybeandigest.com/soybeans/western-bean-cutworm-going-east-0201/

Industry's solution: More hazardous insectcides

The western bean cutworm will be good business for companies even if growing genetically engineered corn proves to be a dead end. Dupont, for instance, which has bought up the seed producer Pioneer, is advertising not only genetically engineered corn but also an extremely toxic pesticide called Asana XL. In Dupont's product information on the internet the real reasons for the spread of western bean cutworm are not mentioned at all:[19]

„As its name suggests, western bean cutworm (WBC) was once primarily a pest of dry beans in the western United States. Now, WBC is considered a threat to field corn in some of the largest corn-producing states. Over the last several years, WBC has gradually migrated eastward through Iowa and into parts of Illinois and Missouri. Many fields in these states have been damaged because growers were simply unaware of the problem. The good news: This relatively new problem can be controlled with a proven product. Count on DuPontTM Asana® XL insecticide to deliver highly effective, economical control of WBC and other insects that threaten your corn."[20]

Asana is only one of several pesticides used against the western bean cutworm. In the internet there are various lists with "suitable" pesticides (see Table 1). Table 1: Insecticides labelled for western bean cutworm in corn.[21]

All the active ingredients listed in the table are substances with one or more problematic properties. Methyl-Parathion is classified as 'extremely hazardous' and zeta-Cypermethrin as 'highly hazardous' by the World Health Organization (IPCS/WHO 2005). Beta-Cyfluthrin and lambda-Cyhalothrin are 'very toxic by inhalation' (Risk Phrase 26) (EC 2008). Due to its potential hazards, certain formulations of methyl-Parathion are listed on Annex III of the Rotterdam Convention[22]. Carbaryl and Permethrin are classified as "probable carcinogenic to humans" and Bifenthrin and zeta-Cypermethrin are classified "possible carcinogenic to humans" by the US EPA (US EPA 2006-2009). Carbaryl, Bifenthrin and lambda-Cyhalothrin are potential endocrine disruptors (Category 1 EU) (EC 2000, EC 2004). All active ingredients are either Pyrethroids or Organophosphates. Grandjean & Landrigan (2006) and Bjørling-Poulsen et al. (2008) con-

19 www2.dupont.com/Production_Agriculture/en_US/assets/downloads/pdfs/K-14370.pdf
20 www2.dupont.com/Production_Agriculture/en_US/assets/downloads/pdfs/K-14370.pdf
21 Quelle: http://www.extension.iastate.edu/CropNews/2009/0727hodgson2.htm?print=true
22 http://www.pic.int/home.php?type=t&id=29&sid=30

Table 1: Insecticides labelled for western bean cutworm in corn.

Product (active ingredient)	***Application rate***	***Preharvest interval***
Adjourn (esfenvalerate)	2.9-5.8 oz/ac	21 days
Ambush (permethrin)	3.2-6.4 oz/ac	30 days
Asana XL (esfenvalerate)	2.9-5.8 oz/ac	21 days
Baythroid XL (beta-cyfluthrin)	1.6-2.8 oz/ac	21 days (0 days for sweet corn)
Bifenthrin 2EC	2.1-6.4 oz/ac	30 days
Lorsban 4E (chlorpyrifos)	1-2 pints/ac	21 days
Mustang Max (zeta-cypermethrin)	1.76-4.0 oz/ac	30 days
Penncap M (methyl parathion)	2-4 pints/ac	12 days
Pounce 1.5G (permethrin)	6.7-13.3 lbs/ac	30 days (for sweet corn only)
Proaxis (gamma-cyhalothrin)	1.92-3.2 oz/ac	21 days
Sevin XLR Plus (carbaryl)	2 quarts/ac	48 days
Warrior II (lambda-cyhalothrin)	0.96-1.6 oz/ac	21 days

Source: http://www.extension.iastate.edu/CropNews/2009/0727hodgson2.htm?print=true sider all pesticides of these chemical classes as neurotoxic. Esfenvalerate and Permethrin may cause sensitization by skin contact (Risk Phrase 43) (EC 2008) and can be considered as immunotoxic.

Eight of the ten active ingredients[23] are classified by the European Union regulation. All eight are "very toxic to aquatic organisms" (Risk Phrase 50) and seven[24] "may cause long-term adverse effects in the aquatic environment" (Risk Phrase 53) (EC 2008). Two[25] active ingredients are highly hazardous to birds (Mineau et al., 2001). Nine are active ingredients[26] and highly toxic to honey bees[27] and seven active ingredients[28] have bioconcentration factors (BCF) greater than 500 and can be considered bioaccumulative. Bifenthrin and Chlorpyrifos also have long half lives in the environment (soil, water, sediments) and can be regarded as persistent (FOOTPRINT 2009). Carbaryl, Permethrin, methyl-Parathion and Bifenthrin have been explicitly excluded from Annex I of Directive 91/414/EC29, the EU positive list for pesticide active ingredients.

23 Carbaryl, Esfenvalerate, beta-Cyfluthrin, Chlorpyrifos, zeta-Cypermethrin, methyl-Parathion, lambda-Cyhalothrin, Permethrin

24 Esfenvalerate, beta-Cyfluthrin, Chlorpyrifos, zeta-Cypermethrin, methyl-Parathion, lambda-Cyhalo thrin, Permethrin

25 Chlorpyrifos, methyl-Parathion

26 Carbaryl, Esfenvalerate, beta-Cyfluthrin, Bifenthrin, Chlorpyrifos, zeta-Cypermethrin, lambda-Cyhalothrin, gamma-Cyhalothrin, Permethrin

27 LD/LC50 below 2µg/bee see: www.epa.gov/oppefed1/ecorisk_ders/toera_analysis_eco.htm

28 Bifenthrin, Esfenvalerate, Chlorpyrifos, lambda-Cyhalothrin, gamma-Cyhalothrin beta-Cyfluthrin, zeta-Cypermethrin,

29 see http://ec.europa.eu/sanco_pesticides/public/index.cfm?event=activesubstance.selection and Commission Decision 2009/887/EC

Some points for discussion

There are reports about problems caused by genetically engineered plants in the cultivation of genetically engineered soy, being herbicide tolerant. In this instance weed has adapted to the permanent use of certain herbicides (glyphosate) and become resistant. Year after year, more species of weeds become resistant (Service, 2007)[30]. At the same time herbicide usage is increasing substantially (Benbrook, 2009).

There is increasing evidence that strategies used for other Bt plants such as cotton or rice need to be reassessed. In 2006, it was reported that pest replacement had been observed in Bt cotton crops grown in China. (Wang, 2006).

In an article in Nature (Qiu, 2008) plans for Bt rice cultivation in China called into question because many of the already known pest insects would not be controlled by the Bt produced in the plants. In the article, a researcher from the International Rice Research Institute IRRI raised a very basic question concerning the general strategy of growing Bt-plants:

„Pests thrive where biodiversity is at peril. Instead of genetic engineering, why don't we engineer the ecology by increasing biodiversity?"

There is a growing need to find alternatives to current practises. One way to achieve more stability in ecosystems is crop rotation. This would help to prevent the adoption of pest organisms to certain crops by permanent year after year cultivation. Another strategy is to produce seeds that help to protect the plants by more complex and sustainable mechanisms: For example for the corn earworm, varieties of corn with tight husks seem to be able to reduce economic damage.[31] This might allow the corn earworm to subsist on the plants without causing much damage and help to control the western bean cutworm.

These strategies are also relevant for Europe. So far, the western bean cutworm has not been observed in the maize fields, but experts are warning that new pest species can appear quickly when advanced by current climate change.[32]

There are other strategies available such as using beneficial insect parasites, soil tillage and integrated pest management. They can be combined in various

30 See also www.weedscience.org
31 See for example cru.cahe.wsu.edu/CEPublications/eb1455e/eb1455e.pdf
32 http://www.lfl.bayern.de/presse/2009/36298/index.php

ways to reduce pests in corn cultivation. Bt toxins can be added to strategies as a valuable tool as long as their use is targeted and time limited.

When talking about alternatives one should keep in mind that before the introduction of the Bt crops only about five percent of corn cultivation areas in the US were sprayed with insecticides[33] – apparently there are several ways to control pest insects and Bt crops could be replaced without calling efficient corn production into question.

33 National Academy of Sciences (NAS), “Genetically Modified Pest-Protected Plants: Science and Regulation (2000), Section 3.1.2, Corn.

Conclusions

The spread of the western bean cutworm should be seen as part of a worrying development that involves basic questions concerning the future of sustainable agriculture. On the one hand, cultivation of genetically engineered plants such as MON810 (YieldGard) are grown to avoid spraying hazardous pesticides (as listed in table 1). On the other hand, pest replacement and pest resistance seem to be an inevitable consequence of any strategy that continuously tries to suppress or eliminate pest organisms. This is especially true for the strategy underlying the usage of Bt crops, since the release of the toxin is not targeted and time limited, but implies permanent exposure throughout the whole period of cultivation.

These crops are sold as a solution but they could easily turn into a trap for farmers in the Corn Belt. The ecosystem is destabilised by suppressing certain insects and at the same time the door is opened to pest replacement and pest resistance in major pest insects. Subsequently farmers will end up doing two things – buying expensive seeds to grow multi-stacked Bt-plants and spraying hazardous pesticides.

At present, it seems that Bt plants are likely to result in high follow up costs for agricultural production and the environment. There is a new struggle going on in the fields with the ever “heavier weaponry” in Bt plants producing several toxins and the simultaneous additional spraying of hazardous pesticides.

References

Bjørling-Poulsen M,. Andersen H.R. & Grandjean P., (2008): Potential developmental neurotoxicity of pesticides used in Europe. Environmental Health 7:50

Butzen, S., Dorhout D., Davis, P., (2007) Spread of Western Bean Cutworm in the U.S. Corn Belt, Crop Insights Vol. 17 No. 10, http://www.mccormickcompany.net/pioneer/cropinsights/63.pdf

Benbrook, C., (2009) Impacts of Genetically Engineered Crops on Pesticide Use: The First Thirteen Years, http://www.organic-center.org/reportfiles/13Years20091116.pdf

Catangui M. A. & Berg R. K., (2006) Western bean cutworm, Striacosta albicosta (Smith) (Lepidoptera: Noctuidae), as a potential pest of transgenic Cry1Ab Bacillus thuringiensis corn hybrids in South Dakota Environmental Entomology 35: 1439-1452.

DiFonzo, C. D., and Hammond R.,(2008) Range expansion of western bean cutworm, Striacosta albicosta (Noctuidae), into Michigan and Ohio. Crop Mgt. Online: doi: 10.1094/CM-2008-0519-01-B

Dorhout, D. L. & Rice, M. E. (2004) First report of western bean cutworm, Richia albicosta (Noctuidae) in Illinois and Missouri. Crop Management

(http://www.plantmanagementnetwork.org/pub/cm/brief/2004/cutworm).

Dorhout, D. L. & Rice M. E., (2010) Intraguild Competition and Enhanced Survival of Western Bean Cutworm (Lepidoptera: Noctuidae) on Transgenic Cry1Ab (MON810) Bacillus thuringiensis Corn, Journal of Economic Entomology 103(1):54-62, doi: 10.1603/EC09247

EC (2000): Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption - preparation of a candidate list of substances as a basis for priority setting. European Commission. Delft.

EC (2004): Commission Staff Working Document SEC (2004) 1372 on implementation of the Community Strategy for Endocrine Disrupters - a range of substances suspected of interfering with the hormone systems of humans and wildlife (COM (1999) 706).

EC (2008): Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006 (Text with EEA relevance) Official Journal L 353, 31.12.2008

Eichenseer, H., Strohbehn, R., Burks, J. (2008) Frequency and Severity of Western Bean Cutworm (Lepidoptera: Noctuidae) Ear Damage in Transgenic Corn Hybrids Expressing Different Bacillus thuringiensis Cry Toxins, Journal of Economic Entomology, Volume 101, 2: 555-563

FOOTPRINT (2009): The FOOTPRINT Pesticide Properties DataBase. Database collated by the University of Hertfordshire as part of the EU-funded FOOTPRINT project (FP6-SSP-022704) (www.eu-footprint.org).

Grandjean, P. & Landrigan P .J., (2006): Developmental neurotoxicity of industrial chemicals; The Lancet 16 368(9553):2167-78.

Hilbeck, A. & Schmidt, J. E. U., (2006) Another view on Bt proteins - How specific are they and what else might they do? Biopesticides International 2(1): 1-50.

Hubbard, K., (2009) Out of Hand, farmers face the consequences of a consolidated seed industry, National Family Farm Coalition, http://farmertofarmercampaign.com

IPCS/WHO (2005): The WHO recommended classification of pesticides by hazard and guidelines to classification 2004, International Programme on Chemical Safety (IPCS) & World Health Organization (WHO), Geneva

Li H., Buschman L. L., Huang F., Zhu K. Y., Bonning B., Oppert B. A., (2007) Resistance to Bacillus thuringiensis endotoxins in the European corn borer, Biopestic. Int. 3: 96-107

Mineau P., Baril A., Collins, B. T., Duffe D., Joerman G. & Luttik R., (2001): Pesticide Acute Toxicity Reference Values for Birds, Rev Environ Contam Toxicol 170:13-74

Ostlie, K. R., Hutchinson W. D. & Hellmich R. L. (eds.), (1997) Bt Corn and European Corn Borer: Long-Term Success Through Resistance Management. North Central Regional Extension Publication NCR 602. University of Minnesota, St. Paul, MN. (www.extension.umn.edu/distribution/cropsystems/DC7055.html)

O'Rourke, P. K., Hutchinson, W. D., (2000) First report of the western bean cutworm, Richia albicosta (Smith) (Lepidoptera: Noctuidae), in Minnesota corn. J. Agric. Urban. Entomol. 17: 213-217.

Qiu J., 2008, Is China ready for GM rice?, Nature 455, 850-852

Rice, M. E., (2000) Western bean cutworm hits northwest Iowa. Integrated Crop Manage. IC-484, 22, Seite 163, Iowa State University Extension, Ames, IA.

Rice, M. E., & Dorhout, D. L., (2006) Western bean cutworm in Iowa,Illinois, Indiana and now Ohio: Did biotech corn influence the spread of this pest? In 2006 Integrated Crop Management Conference, Iowa State University: 165-172.

Schnepf E. et al., (1998) Bacillus thuringiensis and its pesticidal crystal proteins, Microbiol Mol Biol Rev. 62(3): 775-806

Service, Robert, F., (2007) A growing threat down on the farm, Science, Vol 316: 1114-1117

US EPA (2006-2009): Chemicals Evaluated for Carcinogenic Potential. Science Information Management Branch, Health Effects Division Office of Pesticide Programs, U.S. Environmental Protection Agency (US EPA). April 26 2006; September 12, 2007, September 24 2008; September 03 2009

Wang, Shenghui, David R. Just, Per Pinstrup-Andersen, Tarnishing Silver Bullets (2006) Bt Technology Adoption, Bounded Rationality and the Outbreak of Secondary Pest Infestations in China , Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting Long Beach, CA, July 22-26, 2006, http://www.nova-institut.de/news-images/20060725-04/06-07StudyCornell.pdf

Testbiotech
Institute for Independent
Impact Assessment in
Biotechnology

New plant pest caused be genetically engineered corn
The spread of the western bean cutworm causes massive damages in the US

Testbiotech Report prepared for Greenpeace Germany
March 2010

Author: Christoph Then, Coperation Lars Neumeister, Andreas Bauer
Editing: Andrea Reiche