

Genetically modified organisms (GMOs) and their impact on beekeeping.

Facts, Risks, Analytics and Future Developments.

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Co-existence of genetically modified,
conventional and organic crops
FREEDOM OF CHOICE



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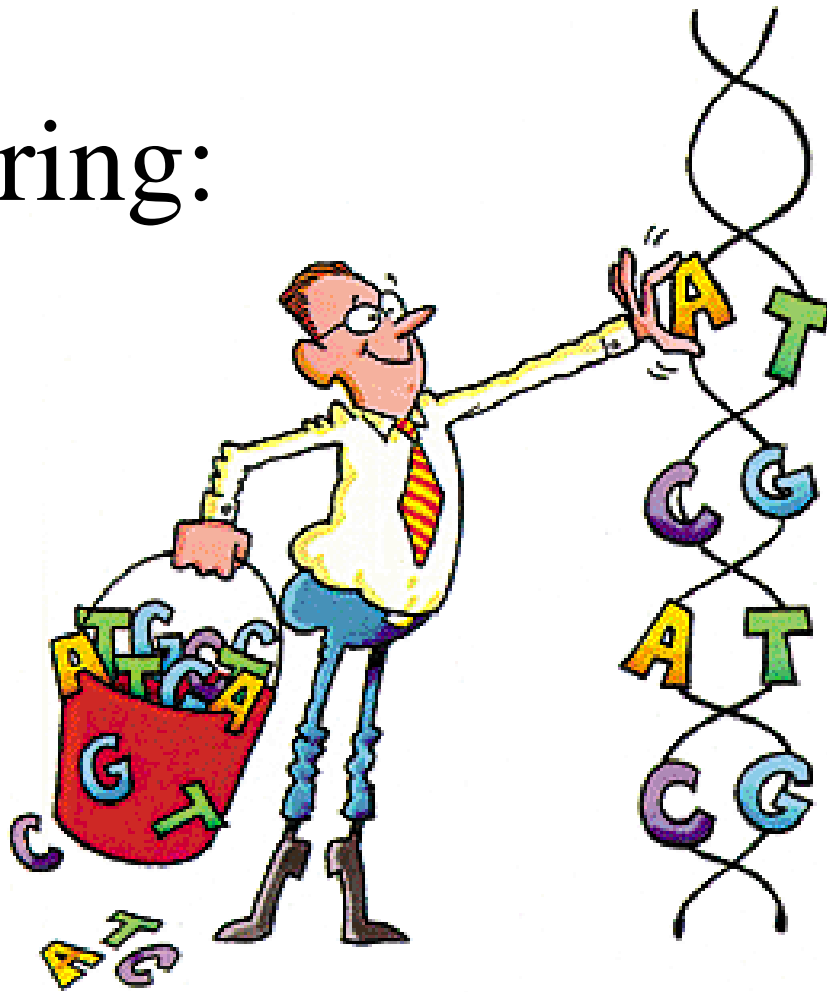
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GMOs

Blessing or Curse?

- Each genetic modification needs to be evaluated separately.
- Some impacts and risks are known today and can be used to make decisions about use.
- Beekeeping must not become „collateral damage“ when GMOs are hastily introduced.

Genetic Engineering: Fiction:



The genetic engineer modifies the DNA: unwanted genes are removed and wanted genes are added...

Genetic Engineering: Reality

- Genes are not precisely inserted, but shot into the target cells with the „gene gun“.
- Genes may not stick at all.
- Genes may end up in the wrong location.
- Genes may stick in multiple locations.



Pharmaceuticals / Industrial

Crops
in closed systems
open fields

reversible
not reversible
enzymes etc.
pharmaceuticals

industrial raw materials
in Laboratory



- reversible
- pharmaceuticals



Applications of genetic engineering

- Agricultural
 - open fields
 - not reversible
 - food
 - feed
 - raw materials
 - renewable energy



Genetic Modifications in Agricultural Crops

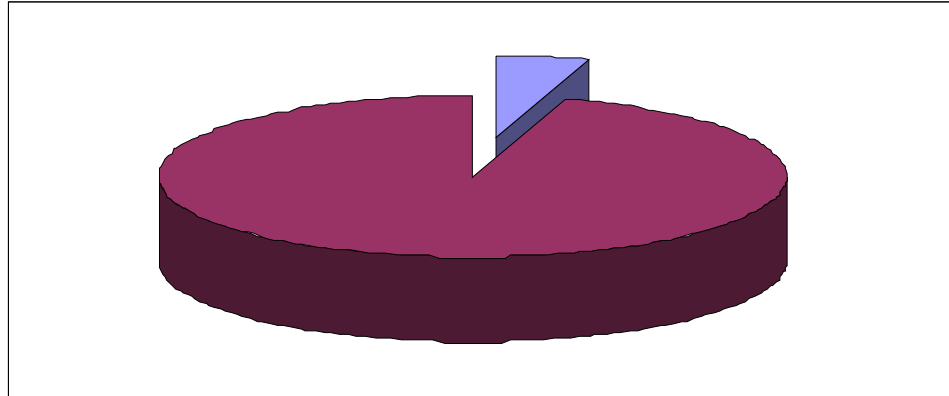
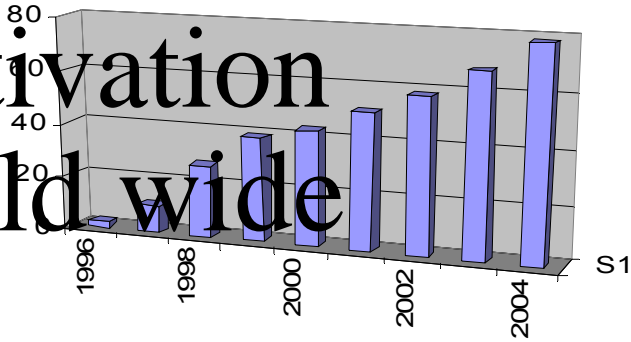
- Plant is resistant to herbicide
 - **RoundUp Ready**
 - **Herbicide kills all other plants.**
 - **Only GMO crop survives.**
 - **Enables more spraying.**
- Plant modified to produce pesticide
 - BT corn, BT canola, BT cotton etc.
 - insect resistance
 - Conventional plant becomes poisonous

Breeding vs. Genetic Modification?

- Breeding selects within the natural variability of the genes of a species
- Konsequences are predictable
- Genetic modification involves transfer of foreign genes into the target organism
- Example: genes from *Bazillus Thuringensis* into corn (BT corn)
- Konsequences unpredictable

Worldwide cultivation of GMOs 1996-2004 (Million Hectar)

GMO
cultivation
world wide



Properties of the most commonly used varieties:

- 75 % Herbicide resistant
- 17 % Insect resistant
- 8 % Herbicide and insect resistant

GMO-Crops

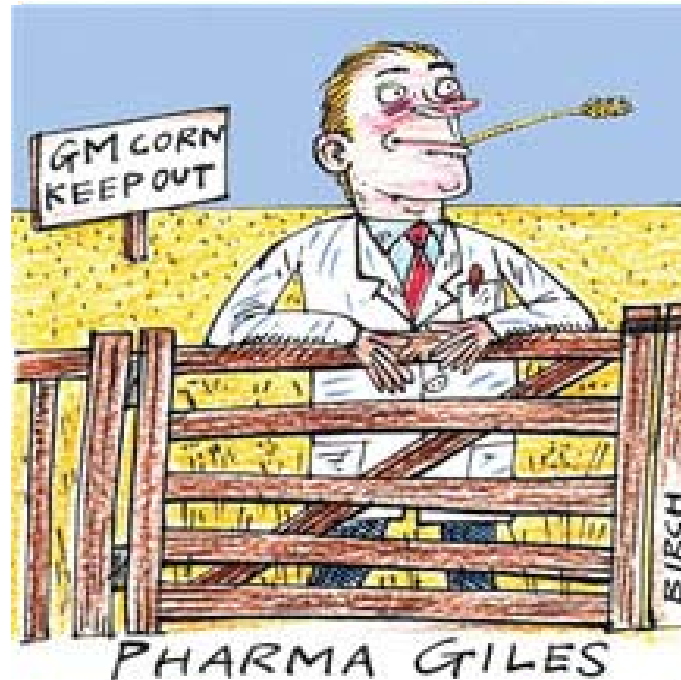


GMOs in the EU

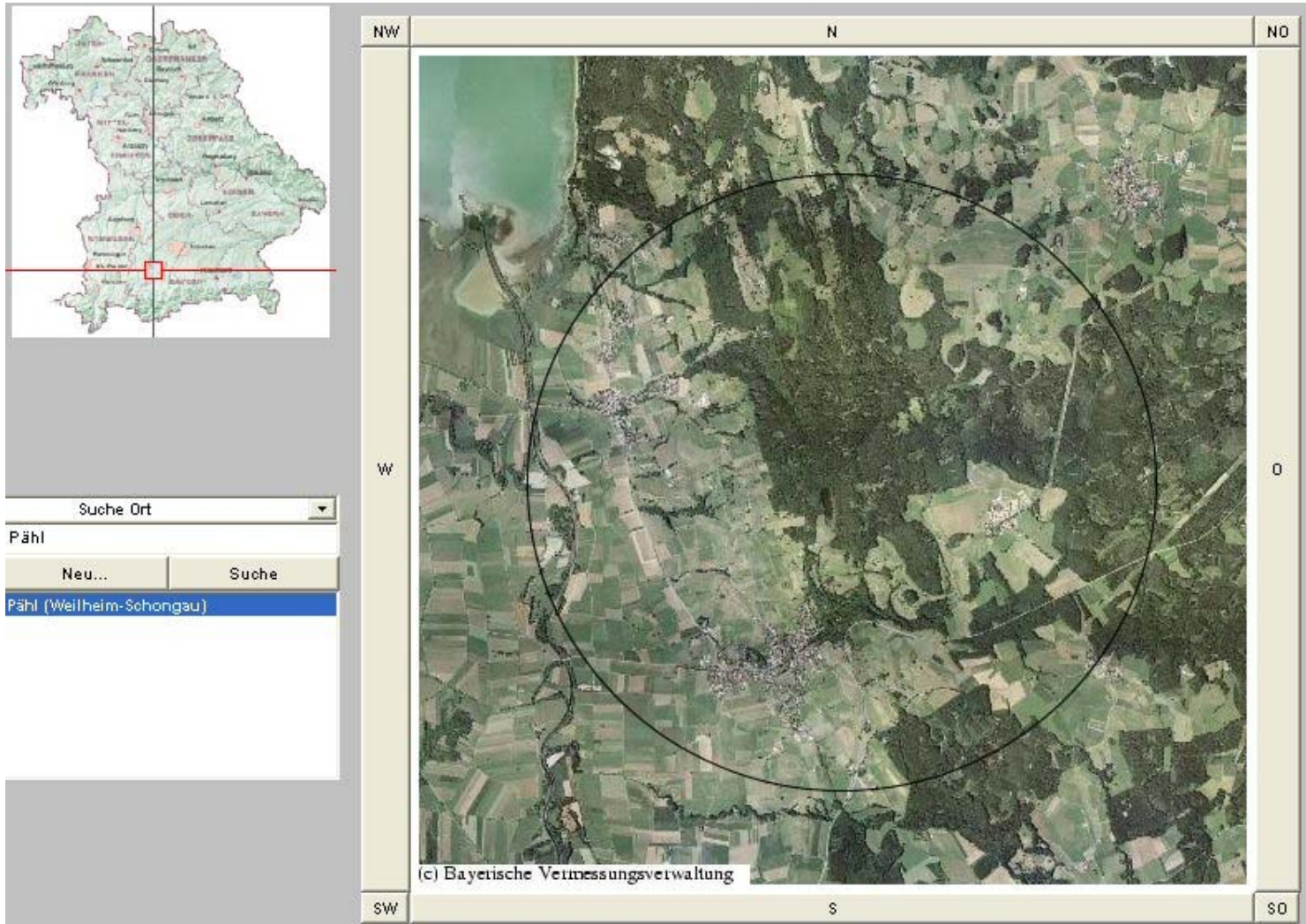
- Coexistence of all production methods: GMO, conventional and organic.
- Freedom of choice for producers and consumers through labeling.
- No labeling of animal products: milk, eggs, meat ... and honey?
- Implementation by member states

Is co-existence possible?

- For which plants is co-existence possible (canola)?
- Field to field co-existence between farmers?
- Co-existence with organic farmers?
- Co-existence with seed production?
- Co-existence with bee keeping?



Action radius of a bee colony: 3 km minimum



GMOs are an uninsurable risk

Insurance companies refuse to cover the risk associated with GMOs:

Letter sent by Allianz Insurance, November 2003:

„Bei diesem Risiko ist das Ausmaß der Schäden schwer einzugrenzen und versicherungstechnisch nicht kalkulierbar. Aus diesem Grund ist die Versicherbarkeit von Gentechnikrisiken leider nicht möglich“

EU-Consumers reject GMOs in Food

- ❑ Supermarkets avoid GM-food.
- ❑ Animal feed is frequently mislabeled as GM
- ❑ Industry sees opportunity in biofuels.
- ❑ Industry is trying to bypass consumer rejection by focussing on renewable energy.

Cost of GMO analysis of honey:

235 € for „Is there any GMO present ?“




+ **80 €** for „Which GMOs are present ?“

+ **150 €** per canola variety for „How much is present?“







(**150 €** bis **300 €** per corn variety)

(Source: Genescan Analytics GmbH, Freiburg)

Freedom of choice for bee keepers and honey customers?

-  The cost of honey analysis for GMOs is extremely high for bee keepers because honey and pollen may contain genes from multiple sources from a large area.
-  Without analysis it is impossible for the bee keeper or the consumer to know if the honey is contaminated.
-  Treating honey as animal product is convenient, but absurd.

Possible Solution: Bio-Monitoring

-  Honey and pollen are a mirror image of the surrounding nature.
-  Bees are ideally suited for Bio-Monitoring.
-  Compliance with a GMO registry could easily be monitored with bees.
-  EU-guidelines already call for Bio-Monitoring.
-  Bee keepers and honey customers would know what's in the honey
-  Society would know what GMOs are present in nature and agriculture.

Possible solution: GMO-free regions

- + Parts of Austria have exemplary rules to manage GMO hazards. (Kärntner Gentechnik Vorsorgegesetz, Oberösterreich, Salzburg, Burgenland, Steiermark)
- + Gentechnikfreie Region entsteht.
- 2004 versuchten Bayern einem „Erprobungsanbau Agro_Gentechnik den E

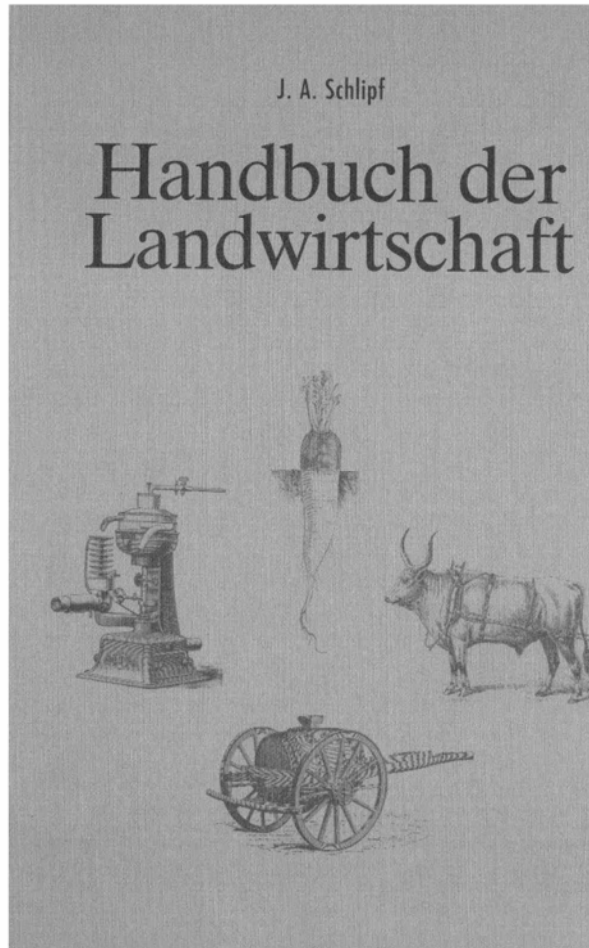


Possible GMO-free

- + Parts of Austria, Italy and Slovenia have exemplary rules to manage GMO hazards. (Kärntner Gentechnik Vorsorgegesetz, Oberösterreich, Salzburg, Burgenland, Steiermark)
- + Gentechnikfreie Region “Bio Alpe Adria” entsteht.



Bee keeping in agriculture anno 1841



Leitende Bienenwohnung ist der als vorzügliche Bienenmehrung bekannte Grabenhorst'sche Bogenstülper.

§ 226. Behandlung der Bienen im Frühjahr.

Nach dem Reinigungsausfluge im Frühjahr werden bei warmem Wetter (10° R.) die Völker untersucht. Man hat hierbei sein Augenmerk namentlich auf die noch vorhandenen Honigvorräte zu richten. Es braucht ein Volk von Anfang März bis zur Baumblüthe noch 7—10 Pfd. Futter, also ebensoviel als in den zurückgelegten Monaten Oktober—Februar. Bei Mobilvölkern ersetzt man das Fehlende durch Einhängen von Honigwaben unter

Entnahme der ausgeleerten Waben. Hat man keinen Honigwabenvorrath, so muß der Zuschuß in flüssigem, erwärmtem Honig gegeben werden und



Fig. 297.

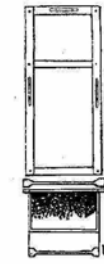








Fig. 298. Bienenkasten.

zwar in höchstens 2 Portionen unmittelbar nacheinander. Zucker oder andere Surrogate im zeitigen Frühjahr zu füttern ist unrationell, weil das Brutgeschäft nur durch Honig gut gefördert wird.







Die Untersuchung der Völker bezieht sich ferner auf die bereits vorhandene Brut und die Weiselrichtigkeit, sowie auf die Volksstärke. Weisellose, sowie durch den Winter schwach gewordene Völker werden am zweckmäßigsten mit Nachbarvölkern vereinigt.

Bei diesen Untersuchungen wird alles Gemüll und alle toten Bienen aus den Stöcken entfernt, etwaige naß oder schimmelig gewordene Waben abgetrocknet oder durch trockene ersetzt und nummehr der Stock wieder recht

Bee keeping and agriculture 2004

-  Bees are desirable and natural.
-  Bees are a blessing for nature and agriculture ...
but:
-  a problem for the agro chemical and biotech industry
-  a problem for the users of pesticides
-  a problem in industrial forestry (harvester)
-  the food industry does not care about european honey

Bee keeping and agriculture 2022

-  Bees used to be desirable and natural.
-  Bees used to be a blessing for nature and agriculture
but ...
-  over 50% of agricultural land not pollinated by bees
-  traditional bee keeping focused on honey production
disappears fast
-  Pollination service with genetically modified „industrial
bees“ by specialized bee keeping operations like in the
USA.
-  Pharmaceutical contaminants in our honey.

Genetically modified „industrial bees“?


Report by the Agriculture and Environment Biotechnology Commission (AEBC)
in the UK - February 2004:


Novel products: Other products in research and development include:

- Advanced textiles and dyes e.g. genetic modification of silkworms to produce spider silk, which because of its use could be used in bullet-proof vests and parachutes¹⁷.
- Specialist adhesives able to bond in wet conditions e.g. for surgical use. Using proteins developed from mussels⁸
- Pest /disease control malaria resistant Mosquitoes
- **GM bees with increase their resistance to disease and parasites.**
- **Insecticide resistant bees so that crops can be sprayed with insecticide without risking pollination problems**

 A varroa-resistant bee would be nice, but ...


 GMOs **genetically modified „industrial bees“** with patents. **resistance to diseases and parasites**

 Only licensed queens by industry legally available.

 Breeding of queens by the bee keeper impossible because patented genes contaminate the gene pool.

 Genetic diversity disappears.

 GMO-Bees divide the bee keeping community.

 First civil war between farmers, then civil war between bee keepers in the rural communities.

 Bee keeping becomes

 Insecticide resistant bees


would be nice, but

 enables use of total insecticides.

 Massive loss of bees for conventional bee keepers

 Pollination only with genetically modified industrial bees.

 No more free pollination for private gardens and nature.

 Honey contaminated with insecticides not marketable.

 GM-bees no longer suitable for bio monitoring.

Insecticide resistant bees enable spraying of fields without jeopardizing pollination service.

Unwanted Apitherapy through Pharma-Crops?

Prof. Dr. Rainer Fischer,

Fraunhofer IME und Lehrstuhl für Molekulare
Biotechnologie an der RWTH Aachen

Quote: "Possible candidates include
maize and tobacco plants, which
could be cultivated by
pharmaceutical companies in
greenhouses or on special fields".

Source: ABIC 2004 - Programm

Unwanted Apitherapy through Pharma-Crops?

Centre for Plant Breeding and Reproduction
Research in Wageningen in the Netherlands:

- GMO Petunias
- Nectar contains proteins for use in a vaccine for dogs.
- Bees are to be used to collect the nectar.
- Pharma-Honey as raw material for vaccine.
- No consideration given to impact on bee keeping in the area of such fields.

Health effects on Honeybees

- **Do GM-Crops endanger the health of honey bees?**
 - **No general statements can be made, since there are many different genetic modifications.**
 - **Insecticides obviously are always potentially dangerous to honeybees and have to be tested prior to approval.**
 - **Plants modified to produce their own insecticide present the same potential danger, but test of honey bee toxicity is not required.**
 - **Only research we are aware of has been done with Bt-crops.**

Bienengesundheit

Aus dem Bericht von Prof. Kaatz aus Biosicherheit.de:

"Prüfung der Wirkung von Bt-Maispollen im Freiland

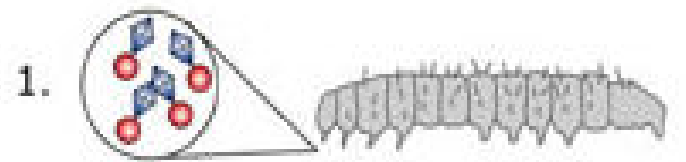
Im ersten Jahr waren die Bienenvölker zufällig mit Parasiten (Mikrosporidien) befallen. Dieser Befall führte bei den Bt-gefütterten Völkern ebenso wie bei den Völkern, die mit Pollen ohne Bt-Toxin gefüttert wurden, zu einer Abnahme der Zahl an Bienen und in deren Folge zu einer verringerten Brutaufzucht. Der Versuch wurde daher vorzeitig abgebrochen.

Dieser Effekt war bei den Bt-gefütterten Völkern signifikant stärker.

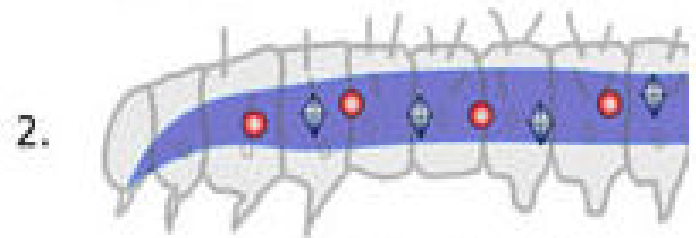
(Die signifikanten Unterschiede sprechen für eine Wechselwirkung von Toxin und Pathogen auf die Epithelzellen des Darms der Honigbiene. Der zugrunde liegende Wirkungsmechanismus ist unbekannt.)

Health effects on Honeybees

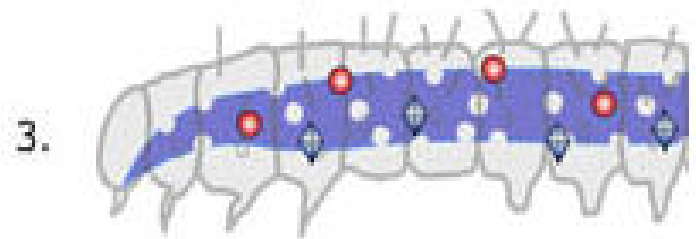
1. Insect eats *Bt* crystals and spores.



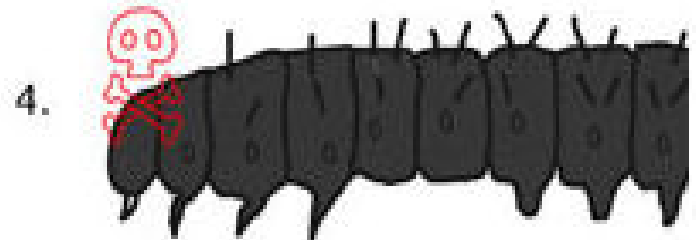
2. The toxin binds to specific receptors in the gut and the insects stops eating.



3. The crystals cause the gut wall to break down, allowing spores and normal gut bacteria to enter the body.



4. The insect dies as spores and gut bacteria proliferate in the body.



Mode of action Bt-Toxin

- Toxins is produced by *Bacillus thuringiensis* to attack the lining of the intestinal tract of it's target insect..
- The bacterium can overcome the immune system of it's target through holes in the lining of the intestinal tract.
- Bt-Corn produces the Bt-Toxins without the presence of the bacillus.
- Target insects of Bt-corn are unaffected, if treated with anti-biotics prior to exposure.
- The effect of Bt-crops on target insects seems to always be due to a opportunistic infection.
- When adult bees digest Bt-Pollen, the Bt-Toxin creates the typical holes in the lining of the intestinal tract.
- These holes become the entry point for common bee diseases, like Mikrosporids (*Nosema apis*).

Bienengesundheit

Der Einfluss der Mikrosporidien konnte nicht weiter untersucht werden, da die Anzucht von Mikrosporidien und damit eine gezielte Infektion von Bienenvölkern nicht gelang.

Bei der Wiederholung des Versuchs wurden die Völker zur Vermeidung einer erneuten Infektion prophylaktisch mit einem Antibiotikum behandelt. In diesem Versuch wurden weder Unterschiede im Brutpflegeverhalten noch in der Larvenentwicklung festgestellt. Die Zahl der adulten Bienen sank in den ersten vier Wochen stärker ab als in den Kontrollvölkern. Im Anschluss daran gab es aber keine Unterschiede mehr."

Where to stay Where to eat What to do When to go

Expert reviews from The Times and travelers like you.

Honeybees Vanish, Leaving Crops and Keepers in Peril



Ann Johansson for The New York Times

Isaias Corona of Bradshaw Honey Farm, near Visalia, Calif., putting corn syrup — bee food — into hives. The farm has lost about half its bees.

By ALEXEI BARRIONUEVO
Published: February 27, 2007

Plantings of Bt-Crops in the U.S.

- "Plantings of Bt corn grew from 8 percent of U.S. corn acreage in 1997
- to 26 percent in 1999, then fell to 19 percent in 2000 and 2001, before climbing to 29 percent in 2003 and 40 percent in 2006"
- "Plantings of Bt cotton expanded more rapidly, from 15 percent of U.S. cotton acreage in 1997 to 37 percent in 2001 and 57 percent in 2006."

Source: <http://151.121.68.30/Data/BiotechCrops/adoption.htm>

Bee Mortality EU vs. US

- Europe:
 - Varroa + poor Pollensupply + Pesticides = 20-50% Losses
- USA:
 - Varroa + poor Pollensupply + Pesticides + Bt-Pollen = 30-70% Losses
- Some Regions in the EU experience higher losses (Spain)

Conclusion

- Independent tests of toxicity to honeybees are needed prior to approval of GM-crops.
- Test for pesticides used in agriculture need to be improved and much more long term regardless of how the pesticide is released into the environment.
- Honeybees and beekeepers are ignored at everyones peril, because society needs the pollination service.
- Honeybees are much more beneficial to agriculture than GM-crops.