GM crops are not the reason for the recent collapse disorder of honeybee colonies called CCD

Klaus Ammann, 20090806, open source version

Contents

ISSUE:

The colony collapse disorder (CCD) is allegedly caused by GM crops

Read the article from the German weekly magazine DER SPIEGEL, the magazine maintains also a website in English: Der Spiegel Online International http://www.spiegel.de/ as a typical example of a sensationa, unsubstantiated European press feature:

Latsch, G. (2007)
Aids im Bienenstock, Der Spiegel 12 pp 58-59 (Der Spiegel Article)
English: http://www.botanischergarten.ch/Bees/Latsch-CCD-Spiegel-2007.pdf , german:
http://www.botanischergarten.ch/Bees/Latsch-Aids-Bienenstock-Spiegel-2007.pdf

Latsch, G. (2007)
Electronic Source: Are GM Crops Killing Bees? , Der Spiegel Online International
published by: Der Spiegel Online March 22, 2007
Spiegel Online for free: http://www.spiegel.de/international/world/0,1518,473166,00.html

As a well known lobbyist for beekeepers Mr. Haefeker has numerous times spoken out against GM crops, in the Spiegel interview he does not make an exception:

"Walter Haefeker is a man who is used to painting grim scenarios. He sits on the board of directors of the German Beekeepers Association (DBIB) and is vice president of the European Professional Beekeepers Association. And because griping is part of a lobbyist's trade, it is practically his professional duty to warn that "the very existence of beekeeping is at stake."
The problem, says Haefeker, has a number of causes, one being the varroa mite, introduced from Asia, and another is the widespread practice in agriculture of spraying wildflowers with herbicides and practicing monoculture. Another possible cause, according to Haefeker, is the controversial and growing use of genetic engineering in agriculture." (Latsch, 2007a, b)

Summary

The assumption, that GM crops could be the cause of Colony Collapse Disorder (CCD) is not substantiated in any scientific documentation of peer reviewed journals. CCD happened decades before ever GM crops showed up, as well as in recently Europe, where the acreage up to now (2009) remains small.

There are a number of different hypothesis as the cause of the CCD documented in the scientific literature, but GM crops per se can be ruled out as a cause and therefore can be labeled as anti-GM-crop scare propaganda.

James Thew from the Ohio State University gives a good summary on the multiple possible causes of CCD and also sums up the history of this still enigmatic disease:

Tew, J.E. (2002)
Bee Culture's Beeyard. In ECAI 2002. 15th European Conference on Artificial Intelligence Proceedings. Dr. James E. Tew, State Specialist, Beekeeping, The Ohio State University, Wooster, OH 44691
http://www.orsba.org/htdocs/download/Dtew.htm AND http://www.botanischergarten.ch/Bees/Tew-Bee-Cultures-Beeyard-2002.PDF
"After several hundred years of observations, there are still plenty of mysteries behind the closed doors of the beehive. As beekeepers, we have always given simple answers to complicated bee questions. In most instances, our only other alternative was to give no answer at all.
During the Spring of 2002, numerous Alabama beekeepers experienced an inexplicable bee colony die-off. There was no obvious cause - even after USDA analysis.
An old diagnosis was called up - The Disappearing Disease of Honey Bees.
My first association with this peculiar ailment was about 20 years ago, when I talked to the late Dr. Walter Rothenbuhler about the sickness. He had attempted to work on the problem, but never made much headway. Though he had performed several research projects, no conclusions were ever drawn. Scant research attention has been allocated to this syndrome over the years. Like an urban legend, the disease lives in scattered paragraphs in bee books near the end of the requisite chapter on bee diseases.
Some History
The condition was first described in 1915 and was called Disappearing Disease because the disease was self-limiting and disappeared. Through the years, that name has increasingly been broadened to describe any mysterious instance where adult bees disappear - not the disease. Confusing isn't it? If the bees have disappeared, then the disease is gone, too. Right? From 1915 until this time, no single pathogen has even been isolated. Other possible names for the ailment are: Spring Dwindling, Fall Dwindling, May Disease, and Autumn Collapse. The Isle of Wight Disease, caused by tracheal mites, has many similarities to Disappearing Disease. The reported symptoms are broad and indistinct appearing to be a collage of characteristics.

In 1915, after a particularly wet Spring, significant colony losses were reported. One beekeeper lost 400 hives. The problem was noted in multiple states from Florida to California. Hives came out the Winter in good shape, but adult bees began to vanish at the beginning of the Spring nectar flow. In afflicted apiaries, at best, honey crops were reduced. At worst, colonies were essentially emptied of adult bees. During subsequent years, now and then, reports were posted presenting Disappearing Disease as the cause of occasional colony losses." (Tew, 2002)

Comments

As a proof that GM crops cannot play a role in CCD, see also some scientific publications from times, when GM crops did not exist yet, at that time the researchers from the Ohio State University Agricultural Research and Development Center called the phenomenon 'Disappearing Disease': in a comprehensive overview, Kulincevic et al published a report for the Research center in Ohio with extensive historic references on the CCD:

Kulincevic, J.M., Rothenbuhler, W.C., & Rinderer, T.E. (1984)
Disappearing Disease .3. a Comparison of 7 Different Stocks of the Honey Bee (Apis-Mellifera). Ohio Agricultural Research and Development Center Research Bulletin, 1160, pp 1-21
<Go to ISI>://A1984TD14900001 AND http://www.botanischergarten.ch/Bees/Kulincevic-Disappearing-1984.pdf AND https://kb.osu.edu/dspace/handle/1811/24687

"Reports of disappearing bees have come from a number of countries over more than 100 years"

"INTRODUCTION
"Disappearing disease" of the honey bee is a mysterious phenomenon. Strong colonies suddenly become weak. Few or no dead bees are seen; bees simply disappear over a few week's time. Many colonies are lost completely.
Reports of disappearing bees have come from a number of countries over more than 100 years. An early example is "the disease of 1868" which struck in Indiana, Kentucky, and Tennessee in anonymous reports: (Anonymous, 1869, 1874). Other examples have come from Australia (Beuhne, 1910, 1916) from Louisiana and Texas in 1963-64 (Oertel, 1965; Williams & Kauffeld, 1974), from California in 1964-65 (Foote, 1966), from Mexico in 1977 (Mraz, personal communitation), from the Rio Grande Valley in Texas in 1974 (Kauffeld et al., 1976) , and from various additional locations in the United States (24). Judging from these reports, there can be no doubt that many beekeepers have suffered devastating losses of bees. An rxtensive review of literature or1 disappearing disease (DD) is given by Wilson and Menapace (Wilson & Menapace, 1979). Various explanations of the cause of the losses have been advanced but most have had little support. Furthermore, there is no reason to believe that all losses gathered under the umbrella of DD are due to the same cause. In fact, many of the earlier cases seem to have occurred In the fall o r early winter, whereas some of the later cases (Wilson & Menapace, 1979) have occurred in the spring. A prominent hypothesis over the last few years has involved some sort of stock detel-ioration (Wilson & Menapace, 1979). It has been suggested that such deterioration may have resulted:

- *from the admixture of African bee genes to the gene pool of North American bees,*
- *from excessive inbreeding of bee stocks, or*
- *from the mal-adaptation to northern climates of bees reared over many generations in the South.*

If such genetic weaknesses exist, it should be possible to obtain evidence of them by a careful comparison of DD with non-DD stocks in the same location. Furthermore, such an investigation should reveal something about the range of variation in North

American bees. Is there sufficient variation to insure success for a program of genetic selection, or are our bees reduced to a uniform genetic mediocrity? Do we have the genetic variation to deal successfully with Africanized bees?
This investigation was designed to compare several stocks of bees with respect to colony population amount of brood, honey, and pollen presence of common bee diseases; and the possible presence and causes of Disappearing Disease." (Kulincevic et al., 1984),
see also other papers of the same authors group: (Kulincevic et al., 1990; Kulincevic & Mladjan, 1988; Kulincevic et al., 1969; Kulincevic et al., 1991a; Kulincevic et al., 1991b, 1992; Kulincevic et al., 1988; Kulincevic et al., 1973; Kulincevic & Rothenbuhler, 1975, 1982, 1989a, b; Kulincevic et al., 1982, 1983).

Most recent information on http://maarec.cas.psu.edu/ColonyCollapseDisorder.html

The latest urgent call for action: more research and monitoring necessary, the case not solved. Also a call for more research beyond the Colony Collapse Disorder.

VanEngelsdorp, D., Hayes, J., & Pettis, J. (2009)
Electronic Source: Preliminary Results: A Survey of Honey Bee Colonies Losses in the U.S. Between September 2008 and April 2009
http://maarec.cas.psu.edu/pdfs/PrelimLosses2009.pdf
AND http://www.botanischergarten.ch/Bees/VanEngelsdorp-PrelimLosses2009.pdf

Cox-Foster, D. & Vanengelsdorp, D. (2009)
Saving the HONEYBEE, Solving the Mystery of the Vanishing Bees. Scientific American, 300, 4, pp 40-+
<Go to ISI>://WOS:000264456700029 AND http://www.scientificamerican.com/article.cfm?id=saving-the-oneybee&print=true
AND http://www.botanischergarten.ch/Bees/Cox-Foster-Solving-the-Mystery1-2009.pdf AND
http://www.scientificamerican.com/article.cfm?id=breakfast-without-bees
(Cox-Foster & Vanengelsdorp, 2009)

Recent Honey Bee Colony Declines, Summary in Science and CSR Report for the US Congress

Also in the latest updates in peer reviewed journal articles from several of the most renowned bee scientists: *GM crops are again not mentioned as a cause of CCD*.

Stokstad, E. (2007)
ENTOMOLOGY: The Case of the Empty Hives. Science %R 10.1126/science.316.5827.970, 316, 5827, pp 970-972
http://www.sciencemag.org/cgi/content/summary/316/5827/970 AND http://www.botanischergarten.ch/Bees/Stockstad-Empty-2007.pdf

"With the recent flap about CCD, insecticides have inevitably been identified as one of the possible causes of larger-than-normal bee loss. The history of the relationship between beekeeping and insecticide application goes back a long way. In the 1950s it took some sleuthing to finally figure out that arsenic dust was being collected by bees in the field as pollen to both their and their colony's detriment. Given the advantages of hindsight, who now could possibly argue that dusting with this extremely toxic substance does not affect honey bees. This even includes the active material in treated wood.1 Another situation arose with the use of microencapsulated pesticides in the 1970s, especially a product called PennCap-M®.2 The capsules were like pollen-grain-size and were a time bomb in colonies because they could be brought back without harm to the forager and only became a problem when consumed by young bees in an effort to feed larvae.
Insecticides were such a problem to beekeepers in the late1970s that congress authorized the beekeeper indemnity program, which provided payments to beekeepers from colonies lost to chemical application in both agricultural and urban (mosquito

control) situations.3 However, this program became unwieldy because it was difficult to tell the difference between legitimate and falsely reported claims, and was finally discontinued. This era brought into use the current information on the effects of pesticides on honey bees, pioneered by Dr. Larry Atkins at the University of California, Riverside for which most extension publications continue to draw their information.4 This was based on topical exposure to workers in small cages (LD50), however, there is evidence that bees may be exposed through other routes, including contaminated nectar, and that measurement of toxicity (LC50) might be significantly different.5 In Florida, this became a hot issue with a material called Temik® used in citrus groves.6 The active ingredient in this material, aldicarb, is a systemic insecticide and was thought to trans-locate into the blooms contaminating nectar. And although the active ingredient is certainly harmful to honey bees, there is evidence that the metabolites (break down products) of this material are even more toxic than the parent substance." (Stokstad, 2007a, b)

Johnson, R. (2007)
Recent Honey Bee Colony Declines, CSR Report for Congress, Order Code RL33938. CSR Report for Congress, Order Code RL33938 pp 13 CSR Report for Congress, Order Code RL33938 Washington (Report)
http://www.botanischergarten.ch/Bees/Johnson-CCD-CRS-2007.pdf

"This report examines the recent sharp decline in U.S. honey bee colonies, which scientists are now calling the Colony Collapse Disorder (CCD). This phenomenon first became apparent among commercial migratory beekeepers along the East Coast during the last few months of 2006, and has since been reported nationwide. Honey bees are the most economically valuable pollinators of agricultural crops worldwide. Many scientists at universities and the U.S. Department of Agriculture (USDA) assert that bee pollination is involved in about one-third of the U.S. diet, and contributes to the production of a wide range of fruits, vegetables, tree nuts, forage crops, some field crops, and other specialty crops. The monetary value of honey bees as commercial pollinators in the United States is estimated at about $15 billion annually.
Honey bee colony losses are not uncommon. However, current losses seem to differ from past situations in that ! colony losses are occurring mostly because bees are failing to return to the hive (which is largely uncharacteristic of bee behavior), ! bee colony losses have been rapid, colony losses are occurring in large numbers, and the reason why these losses are occurring remains still largely unknown.
To date, the potential causes of CCD, as reported by the scientists who are researching this phenomenon, include but may not be limited to parasites, mites, and disease loads in the bees and brood;

- *known/unknown pathogens;*
- *poor nutrition among adult bees;*
- *level of stress in adult bees (e.g., transportation and confinement of bees, or other environmental or biological stressors);*
- *chemical residue/contamination in the wax, food stores and/or bees;*
- *lack of genetic diversity and lineage of bees; and*
- *a combination of several factors.*

On March 29, 2007, the House Subcommittee on Horticulture and Organic Agriculture held a hearing to review the recent honey bee colony declines reported throughout the United States. Based on information presented to Congress, both by scientists researching recent bee colony declines and by agricultural producers who may be potentially affected by these losses, Congress could consider options for subsequent action in this area."
(Johnson, 2007; Johnson et al., 2009)

van Engelsdorp, D., Foster, D.C., Frazier, M., Ostiguy, N., & Hayes, J. (2006)
Electronic Source: "Fall-Dwindle Disease": Investigations into the causes of sudden and alarming colony losses experienced by beekeepers in the fall of 2006. Preliminary Report: First Revision, CCD Working Group Preliminary Report
published by: Bee Alert Inc., Florida Dept. of Agriculture, Pennsylvania State University, Pennsylvania Dept. of Agriculture, USDA/ARS, 22pp
http://www.botanischergarten.ch/Bees/vanEngelsdorp-CCD-working-group-Update-2007.pdf AND
http://www.doacs.state.fl.us/pi/plantinsp/apiary/fall_dwindle_report.pdf

van Engelsdorp, D., Hayes, J., Jr., Underwood, R.M., & Pettis, J. (2008)
A Survey of Honey Bee Colony Losses in the US, Fall 2007 to Spring 2008. PLoS ONE, 3, 12, pp Article No.: e4071
<Go to ISI>://BIOSIS:PREV200900336218 AND
http://www.botanischergarten.ch/Bees/vanEngelsdorp-Survey-Colony-Losses-2008.pdf

Background: *Honey bees are an essential component of modern agriculture. A recently recognized ailment, Colony Collapse Disorder (CCD), devastates colonies, leaving hives with a complete lack of bees, dead or alive. Up to now, estimates of honey bee population decline have not included losses occurring during the wintering period, thus underestimating actual colony mortality. Our survey quantifies the extent of colony losses in the United States over the winter of 2007–2008.*
Methodology/Principal Findings*: Surveys were conducted to quantify and identify management factors (e.g. operation size, hive migration) that contribute to high colony losses in general and CCD symptoms in particular. Over 19% of the country's estimated 2.44 million colonies were surveyed. A total loss of 35.8% of colonies was recorded; an increase of 11.4% compared to last year. Operations that pollinated almonds lost, on average, the same number of colonies as those that did not. The 37.9% of operations that reported having at least some of their colonies die with a complete lack of bees had a total loss of 40.8% of colonies compared to the 17.1% loss reported by beekeepers without this symptom.* ***Large operations were more likely to have this symptom suggesting that a contagious condition may be a causal factor.*** *Sixty percent of all colonies that were reported dead in this survey died without dead bees, and thus possibly suffered from CCD. In PA, losses varied with region, indicating that ambient temperature over winter may be an important factor.*
Conclusions/Significance: *Of utmost importance to understanding the recent losses and CCD is keeping track of losses over time and on a large geographic scale. Given that our surveys are representative of the losses across all beekeeping operations, between 0.75 and 1.00 million honey bee colonies are estimated to have died in the United States over the winter of 2007–2008. This article is an extensive survey of U.S. beekeepers across the continent, serving as a reference for comparison with future losses as well as providing guidance to future hypothesis-driven research on the causes of colony mortality. (van Engelsdorp et al., 2006; van Engelsdorp et al., 2008)*

Imidacloprid or other pesticides as possible cause of CCD?

In France, the use of Imidacloprid was blamed for the cause of CCD and was therefore banned.
http://en.wikipedia.org/wiki/Imidacloprid_effects_on_bee_population

It's of course difficult to be sure if this particular insecticide is the cause of the problem, it was banned in France, but many different pesticides could cause this problem. The FAO website gives a list of relative toxicity of pesticides.
http://www.fao.org/docrep/X0083E/X0083E09.htm

It's not sure if it is still used in the US - some insects might have developed a resistance to this pesticide, but Nguyen et al. demonstrate that Imidacloprid seed-treated maize has *no negative impact on honey bees*:

Nguyen, B.K., Saegerman, C., Pirard, C., Mignon, J., Widart, J., Tuirionet, B., Verheggen, F.J., Berkvens, D., De Pauw, E., & Haubruge, E. (2009)
Does Imidacloprid Seed-Treated Maize Have an Impact on Honey Bee Mortality? Journal of Economic Entomology, 102, 2, pp 616-623
<Go to ISI>://WOS:000264899500021 AND http://www.botanischergarten.ch/Bees/Nguyen-Imidacloprid-Seed-2009.pdf

"Beekeepers suspected maize. Zea mays L., treated with imidacloprid to result in substantial loss of honey bee (Hymenoptera: Apidae) colonies in Belgium. The objective of this study was to investigate the potential impact of maize grown from imidacloprid-treated seeds on honey bee mortality. A survey of 16 apiaries was carried out, and all maize fields treated or not with imidacloprid were located within a radius of 3,000 m around the observed apiaries. Samples of honey, beeswax, and bees were collected in three colonies per apiary and analyzed for pesticide contain by liquid chromatography-tandem mass spectrometry and gas chromatography-tandem mass spectrometry. We first found significant correlation between the number

of colonies per apiary and the mortality rates in an apiary. In addition, this mortality rate was inversely correlated with the surface of maize fields treated and not with imidacloprid, suggesting that this pesticide do not interact with bees fitness. ***Moreover, a very large number of our samples contained acarcides either prohibited or ineffective against varroa destructor (Anderson & Trueman) (Acari: Varroidae), suggesting that the treatment method used by the beekeepers to be inadequate or mite control. Our results support the hypothesis that imidacloprid seed-treated maize has no negative impact on honey bees.*** *(Nguyen et al., 2009)*

New possible cause of the Colony Collapse Disorder: Entombed Pollen ?

In a recent publication a new hypothesis has been erected: Is it possible, that a newly discovered condition is the cause of the CCD: Entombed Pollen seems to contain a transmittable, up to now unknown factor as the cause for the disease:

Van Engelsdorp, D., Evans, J.D., Donovall, L., Mullin, C., Frazier, M., Frazier, J., Tarpy, D.R., Hayes, J., & Pettis, J.S. (2009)
"Entombed Pollen": A new condition in honey bee colonies associated with increased risk of colony mortality. Journal of Invertebrate Pathology, 101, 2, pp 147-149
<Go to ISI>://WOS:000267382800012 AND http://www.botanischergarten.ch/Bees/VanEngelsdorp-Entombed-Pollen-2009.pdf
"Here we describe a new phenomenon, entombed pollen, which is highly associated with increased colony mortality. Entombed pollen is sunken, capped cells amidst "normal", uncapped cells of stored pollen, and some of the pollen contained within these cells is brick red in color. There appears to be a lack of microbial agents in the pollen, and larvae and adult bees do not have an increased rate of mortality when they are fed diets supplemented with entombed pollen in vitro, suggesting that the pollen itself is not directly responsible for increased colony mortality. However, the increased incidence of entombed pollen in reused wax comb Suggests that there is a transmittable factor common to the phenomenon and colony mortality. In addition, there were elevated pesticide levels, notably of the fungicide chlorothalonil, in entombed pollen. Additional studies are needed to determine if there is a causal relationship between entombed pollen, chemical residues, and colony mortality." (Van Engelsdorp et al., 2009)

Energetic stress as a possible cause for the Colony Collapse Disorder ?

On another hypothesis it is infection with Nosema ceranae being responsible via energetic stress for the disease:

Mayack, C. & Naug, D. (2009)
Energetic stress in the honeybee Apis mellifera from Nosema ceranae infection. Journal of Invertebrate Pathology, 100, 3, pp 185-188 <Go to ISI>://WOS:000264850500007
AND http://www.botanischergarten.ch/Bees/Maycack-Energetic-Stress-Nosema 2009.pdf

"Parasites are dependent on their hosts for energy to reproduce and can exert a significant nutritional stress on them. Energetic demand placed oil the host is especially high in cases where the parasite-host complex is less co-evolved. The higher virulence of the newly discovered honeybee pathogen, Nosema ceranae, which causes a higher mortality in its new host Apis mellifera, might be based on a similar the mechanism. Using Proboscis Extension Response and feeding experiments, we show that bees infected with N. ceranae have a higher hunger level that leads to a lower survival Significantly, we also demonstrate that the survival of infected bees fed ad libitum is not different from that Of uninfected bees. These results demonstrate that energetic stress is the probable cause of the shortened life span observed in infected bees. We argue that energetic stress can lead to the precocious and risky foraging observed in Nosema infected bees and discuss its relevance to colony collapse syndrome. the significance of energetic stress as a general mechanism by which infectious diseases influence host behavior and physiology is discussed." (Mayack & Naug, 2009)

A Virus (IAPV, Israeli Acute Paralysis Virus) might be the cause of CCD

Cox-Foster, D., S. Conlan, E. C. Holmes, G. Palacios, A. Kalkstein, J. D. Evans, N. A. Moran, P. L. Quan, D. Geiser, T. Briese, M. Hornig, J. Hui, D. Vanengelsdorp, J. S. Pettis and W. I. Lipkin (2008). "The latest buzz about colony collapse disorder - Response." Science 319: 725-725.
<Go to ISI>://WOS:000252963000016 AND http://www.botanischergarten.ch/Bees/Anderson-Cox-Foster-Controversy-2008.pdf

"THE REPORT "A METAGENOMIC SURVEY OF microbes in honey bee colony collapse disorder" (D. L. Cox-Foster et al., 12 October 2007, p. 283) identified Israeli acute paralysis virus (IAPV) as a putative marker for colony collapse disorder (CCD). It also purports to show a relationship between U.S. colony declines as early as 2004 and importations of Australian honeybees. We believe these links are tenuous for several reasons: (i) Importations of Australian honeybees to the United States did not commence until 2005. (ii) No evidence is presented for a causal link between IAPV and CCD. Koch's postulates, as modified for including IAPV, do not respect national boundaries. IAPV is not confined to the United States or Australia. It has also been found in bees in Israel and royal jelly from Manchuria. We anticipate that with the new focus on IAPV and the distribution of diagnostic reagents, we will learn that it is even more widely distributed. Nonetheless, IAPV lineages have now been found in U.S. bees; one of them correlates genetically with IAPV found in bees in Australian shipments. The presence of IAPV strains in older U.S. samples does not eliminate a role for this virus in CCD."
(Cox-Foster et al., 2008; Cox-Foster et al., 2007a; Cox-Foster et al., 2007b)

Maori, E., N. Paldi, S. Shafir, H. Kalev, E. Tsur, E. Glick and I. Sela (2009). "IAPV, a bee-affecting virus associated with Colony Collapse Disorder can be silenced by dsRNA ingestion." Insect Molecular Biology **18**(1): 55-60.
<Go to ISI>://WOS:000262516400006 AND http://www.botanischergarten.ch/Bees/Maori-IAPV-Silenced-2009.pdf

"Colony Collapse Disorder (CCD) has been associated with Israeli acute paralysis virus (IAPV). CCD poses a serious threat to apiculture and agriculture as a whole, due to the consequent inability to provide the necessary amount of bees for pollination of critical crops. Here we report on RNAi-silencing of IAPV infection by feeding bees with double-stranded RNA, as an efficient and feasible way of controlling this viral disease. The association of CCD with IAPV is discussed, as well as the potential of controlling CCD." (Maori et al., 2007; Maori et al., 2009)

Palacios, G., J. Hui, P. L. Quan, A. Kalkstein, K. S. Honkavuori, A. V. Bussetti, S. Conlan, J. Evans, Y. P. Chen, D. vanEngelsdorp, H. Efrat, J. Pettis, D. Cox-Foster, E. C. Holmes, T. Briese and W. I. Lipkin (2008). "Genetic analysis of Israel acute paralysis virus: Distinct clusters are circulating in the United States." Journal of Virology 82(13): 6209-6217.
<Go to ISI>://WOS:000256947300012 AND http://www.botanischergarten.ch/Bees/Palacios-Genetic-Analysis-2008.pdf

"Israel acute paralysis virus (IAPV) is associated with colony collapse disorder of honey bees. Nonetheless, its role in the pathogenesis of the disorder and its geographic distribution are unclear. Here, we report phylogenetic analysis of IAPV obtained from bees in the United States, Canada, Australia, and Israel and the establishment of diagnostic real-time PCR assays for IAPV detection. Our data indicate the existence of at least three distinct IAPV lineages, two of them circulating in the United States. Analysis of representatives from each proposed lineage suggested the possibility of recombination events and revealed differences in coding sequences that may have implications for virulence." (Palacios et al., 2008)

Ribiere, M., V. Olivier, P. Blanchard, F. Schurr, O. Celle, P. Drajnudel, J. P. Faucon, R. Thiery and M. P. Chauzat (2008). "The collapse of bee colonies: the CCD case ("Colony collapse disorder") and the IAPV virus (Israeli acute paralysis virus)." Virologie **12**(5): 319-322.
<Go to ISI>://WOS:000262852300001 AND http://www.botanischergarten.ch/Bees/Ribiere-CCD-Virologie-2008.pdf

Conclusion
En conclusion, en l'absence de données quant au lien de causalité entre la présence de ces virus et les pertes aux États-Unis comme en France, des recherches restent nécessaires afin d'évaluer leur implication dans les phénomènes d'affaiblissements et de mortalités de colonies d'abeilles.
Cependant, il faut garder à l'esprit que d'autres facteurs peuvent être impliqués dans ces dépérissements de colonies. Ainsi, on peut lister les différents pathogènes qui agissent seuls ou en concomitance, la compétition interspécifique entre les différentes espèces d'abeilles particulièrement sur le continent américain, l'usage de races d'abeilles nouvellement introduites dans des

régions données, le morcellement des habitats qui est la conséquence du développement des grandes cultures ou de l'introduction des espèces végétales envahissantes, et l'usage des pesticides. La clé de la compréhension des phénomènes d'affaiblissements des colonies d'abeilles passe par l'approche intégrative de ces différents facteurs. (Ribiere et al., 2008)

Teixeira, E. W., Y. P. Chen, D. Message, J. Pettis and J. D. Evans (2008). "Virus infections in Brazilian honey bees." Journal of Invertebrate Pathology **99**(1): 117-119.
<Go to ISI>://WOS:000259131400018 AND http://www.botanischergarten.ch/Bees/Weinstein-Teixeira-Virus-Brazil-2008.pdf

"This work describes the first molecular-genetic evidence for viruses in Brazilian honey bee samples. Three different bee viruses, Acute bee paralysis virus (ABPV), Black queen cell Virus (BQCV), and Deformed wing virus (DWV) were identified during a screening of RNAs from 1920 individual adult bees collected in a region of southeastern Brazil that has recently shown unusual bee declines. ABPV was detected in 27.1% of colony samples, while BQCV and DWV were found in 37% and 20.3%, respectively. These levels are substantially lower than the frequencies found for these viruses in Surveys from other parts of the world. We also developed and validated a Multiplex RT-PCR assay for the simultaneous detection of ABPV, BQCV, and DWV in Brazil." (Teixeira et al., 2008)

Bt crops can be ruled out as stress factor of honey bees

Duan, J. J., M. Marvier, J. Huesing, G. Dively and Z. Y. Huang (2008). "A Meta-Analysis of Effects of Bt Crops on Honey Bees (Hymenoptera: Apidae)." PLoS ONE **3**(1): e1415.

http://dx.doi.org/10.1371%2Fjournal.pone.0001415 AND http://www.botanischergarten.ch/Bt/Duan-Meta-Analysis-Effects-Bees-2008.pdf

"Background: Honey bees (Apis mellifera L.) are the most important pollinators of many agricultural crops worldwide and are a key test species used in the tiered safety assessment of genetically engineered insect-resistant crops. There is concern that widespread planting of these transgenic crops could harm honey bee populations. Methodology/Principal Findings: We conducted a meta-analysis of 25 studies that independently assessed potential effects of Bt Cry proteins on honey bee survival (or mortality). Our results show that Bt Cry proteins used in genetically modified crops commercialized for control of lepidopteran and coleopteran pests do not negatively affect the survival of either honey bee larvae or adults in laboratory settings. Conclusions/Significance: Although the additional stresses that honey bees face in the field could, in principle, modify their susceptibility to Cry proteins or lead to indirect effects, our findings support safety assessments that have not detected any direct negative effects of Bt crops for this vital insect pollinator." (Duan et al., 2008)

Ramirez-Romero, R., Desneux, N., A., D., Chaffiol, A., & Pham-Delegue, M.H. (2008)
Does Cry1Ab protein affect learning performances of the honey bee Apis mellifera L. (Hymenoptera, Apidae)?
Ecotoxicology and Environmental Safety, In Press, Corrected Proof, pp
http://www.sciencedirect.com/science/article/B6WDM-4RWK072-2/2/123e7dfc2ecddadee7da81bca89cc97e AND
http://www.botanischergarten.ch/Bt/Ramirez-Romero-Affect-Bees-2008.pdf

"Genetically modified Bt crops are increasingly used worldwide but side effects and especially sublethal effects on beneficial insects remain poorly studied. Honey bees are beneficial insects for natural and cultivated ecosystems through pollination. The goal of the present study was to assess potential effects of two concentrations of Cry1Ab protein (3 and 5000 ppb) on young adult honey bees. Following a complementary bioassay, our experiments evaluated effects of the Cry1Ab on three major life traits of young adult honey bees: (a) survival of honey bees during sub-chronic exposure to Cry1Ab, (b) feeding behavior, and (c) learning performance at the time that honey bees become foragers. The latter effect was tested using the proboscis extension reflex (PER) procedure. The same effects were also tested using a chemical pesticide, imidacloprid, as positive reference. The tested concentrations of Cry1Ab protein did not cause lethal effects on honey bees. However, honey bee feeding behavior was affected when exposed to the highest concentration of Cry1Ab protein, with honey bees taking longer to imbibe the contaminated syrup. Moreover, honey bees exposed to 5000 ppb of Cry1Ab had disturbed learning performances. Honey bees

continued to respond to a conditioned odor even in the absence of a food reward. Our results show that transgenic crops expressing Cry1Ab protein at 5000 ppb may affect food consumption or learning processes and thereby may impact honey bee foraging efficiency. The implications of these results are discussed in terms of risks of transgenic Bt crops for honey bees. " (Ramirez-Romero et al., 2008).

Natural infection by Nosema ceranae or other infections the cause of CCD ?

Higes, M., R. Martin-Hernandez, C. Botias, E. G. Bailon, A. V. Gonzalez-Porto, L. Barrios, M. J. del Nozal, J. L. Bernal, J. J. Jimenez, P. G. Palencia and A. Meana (2008). "How natural infection by Nosema ceranae causes honeybee colony collapse." Environmental Microbiology 10(10): 2659-2669.
<Go to ISI>://WOS:000259147900017 AND http://www.botanischergarten.ch/Bees/Higes-Natural-Infection-Nosema-2008.pdf

"In recent years, honeybees (Apis mellifera) have been strangely disappearing from their hives, and strong colonies have suddenly become weak and died. The precise aetiology underlying the disappearance of the bees remains a mystery. However, during the same period, Nosema ceranae, a microsporidium of the Asian bee Apis cerana, seems to have colonized A. mellifera, and it's now frequently detected all over the world in both healthy and weak honeybee colonies. For first time, we show that natural N. ceranae infection can cause the sudden collapse of bee colonies, establishing a direct correlation between N. ceranae infection and the death of honeybee colonies under field conditions. Signs of colony weakness were not evident until the queen could no longer replace the loss of the infected bees. The long asymptomatic incubation period can explain the absence of evident symptoms prior to colony collapse. Furthermore, our results demonstrate that healthy colonies near to an infected one can also become infected, and that N. ceranae infection can be controlled with a specific antibiotic, fumagillin. Moreover, the administration of 120 mg of fumagillin has proven to eliminate the infection, but it cannot avoid reinfection after 6 months. We provide Koch's postulates between N. ceranae infection and a syndrome with a long incubation period involving continuous death of adult bees, non-stop brood rearing by the bees and colony loss in winter or early spring despite the presence of sufficient remaining pollen and honey." (Higes et al., 2008a; Higes et al., 2008b)

Pajuelo, A. G., C. Torres and F. J. O. Bermejo (2008). "Colony losses: a double blind trial on the influence of supplementary protein nutrition and preventative treatment with fumagillin against Nosema ceranae." Journal of Apicultural Research **47**(1): 84-86.<Go to ISI>://WOS:000254014000014 AND http://www.botanischergarten.ch/Bees/Pajuelo-Colony-Losses-2008.pdf

Serious losses of honey bee colonies have been commanding the attention of the Spanish beekeeping sector over the last few years. It is thought that the problem has been caused by the joint action of a series of factors that could be provoking an immunosuppressive reaction in bees, making them more susceptible to previously known diseases such as: European Foul Brood (Melissococcus pluton); American Foul Brood (Paenibacil/us larvae); chalk brood (Ascosphaem apis); viruses and Varroa destructor, and new emerging diseases such as Nosema ceronae. These factors are thought to include: climatologically difficult years with a consequential nutritional impact on colonies, the effect of neonicotinoid insecticides, and unsuitable management practices. Nutritional problems caused by climatic conditions are not new to apiculture. In Australia, there were similar occurrences at the end of the 1970s (Kleinschmidt & Kondos, 1979) cand in the USA, (Sanford, 1987, 2007; Savoy et al., 1997) cites the so-called "Stress Accelerated Decline". The Iberian Peninsula has recently been experiencing the hottest years since temperature was first recorded, two of the four hottest years being 2003 and 2004 (European Environmental Agency. www.eea.eu.intlmain <http://www.eea.eu.intlmain>). (Pajuelo et al., 2008).

McMullan, J. B. and M. J. F. Brown (2009). "A qualitative model of mortality in honey bee (Apis mellifera) colonies infested with tracheal mites (Acarapis woodi)." Experimental and Applied Acarology **47**(3): 225-234.
<Go to ISI>://WOS:000262972100005 AND http://www.botanischergarten.ch/Bees/McMullan-Qualitative-Model-Mortality-2009.pdf

"The tracheal mite has been associated with colony deaths worldwide since the mite was first discovered in 1919. Yet controversy about its role in honey bee colony mortality has existed since that time. Other pathogens such as bacteria and viruses have been suggested as the cause of colony deaths as well as degenerative changes in individual honey bees. Using data

from published work we developed a qualitative mortality model to explain colony mortality due to tracheal mite infestation in the field. Our model suggests that colonies of tracheal-mite infested honey bees, with no other pathogens present, can die out in the late winter/early spring period due to their inability to thermoregulate. An accumulation of factors conspire to cause colony death including reduced brood/bee population, loose winter clusters, reduced flight muscle function and increasing mite infestation. In essence a cascade effect results in the colony losing its cohesion and leading to its ultimate collapse." (McMullan & Brown, 2009)

Could climate change contribute to the colony collapse of honey bees ?

Le Conte, Y. and M. Navajas (2008). "Climate change: impact on honey bee populations and diseases." Revue Scientifique Et Technique-Office International Des Epizooties **27**(2): 499-510.
<Go to ISI>://WOS:000259353700017 AND http://www.botanischergarten.ch/Bees/Leconte-Climate-Change-Bees-2008.pdf

"The European honey bee, Apis mellifera, is the most economically valuable pollinator of agricultural crops worldwide. Bees are also crucial in maintaining biodiversity by pollinating numerous plant species whose fertilisation requires an obligatory pollinator. Apis mellifera is a species that has shown great adaptive potential, as it is found almost everywhere in the world and in highly diverse climates. In a context of climate change, the variability of the honey bee's life-history traits as regards temperature and the environment shows that the species possesses such plasticity and genetic variability that this could give rise to the selection of development cycles suited to new environmental conditions. Although we do not know the precise impact of potential environmental changes on honey bees as a result of climate change, there is a large body of data at our disposal indicating that environmental changes have a direct influence on honey bee development. In this article, the authors examine the potential impact of climate change on honey bee behaviour, physiology and distribution, as well as on the evolution of the honey bee's interaction with diseases. Conservation measures will be needed to prevent the loss of this rich genetic diversity of honey bees and to preserve ecotypes that are so valuable for world biodiversity." (Le Conte & Navajas, 2008a, b)

Colony Collapse Disorder: Many suspects, no smoking gun

Watanabe, M. E. (2008). "Colony collapse disorder: Many suspects, no smoking gun." Bioscience **58**(5): 384-388.
<Go to ISI>://WOS:000255971600005 AND http://www.botanischergarten.ch/Bees/Watanabe-CCD-Many-Suspects-2008.pdf

"From the text:
The evidence to date Honey bees (Apis mellifera) can be loaded with parasites. Varroa mites (Varroa destructor) are relatively large ectoparasites that feed on bee hemolymph (insect "blood") and wreak havoc in hives. Tracheal mites (Acarapis woodi [Rennie]) attach to the bees' breathing apparatus and suck out hemolymph, injecting the bees with bacteria and weakening and killing adult bees. And two species of microsporidia, Nosema apis and Nosema ceranae, can infect a bee's gut, damaging its digestive tract, exposing it to numerous bacteria and viruses, and shortening its lifespan. Bees are also subject to all sorts of chemical insults, especially environmental and in-hive insecticides and in -hive antibiotics, as well as to stress.
***And about the virus hypothesis**: The most pressing question at present, however, is whether a virus is causing the die-off. (Cox-Foster et al., 2008; Cox-Foster et al., 2007a) led a study, published last fall (12 October 2007 Science), to identify microbial species associated with CCD affected migratory bee operations. Sequences from at least eight species of bacteria (some uncultured), two species of fungi, the two Nosema microsporidians, one trypanosome, the varroa mite, and seven virus species were found in the affected bees. Cox-Foster and colleagues concluded that Israeli acute paralysis virus (IAPV), which was identified only recently; is a marker for CCD but not necessarily the cause. W Ian Lipkin, from the Mailman School of Public Health at Columbia University in New York, who did much of the genetic work for the article, says that his group is now studying the distribution of IAPV. First described in Israel in 2004, IAPV has been present in the United States since before 2006. It was identified in material found in the US Department of agriculture's freezers dating from 2002. (Hackenberg remarks that there were similar-appearing die-offs in 2004 and 2005, though on a lesser scale than in 2006.) Cox-Foster explains that Lipkin's group has identified three complete viral genomes: one found in honey bees from Australia, another from Israel, and a third in affected bee operations in the eastern United States and from two sites in Canada (New Brunswick and British Columbia). The Australian virus sequence matches sequences identified in bee operations in California and other states in the western United States. This makes sense, because beginning in 2005, under pressure from almond growers, the US Congress passed an exemption to the*

Honeybee Act of 1922, which forbade all importation of honey bees to prevent the spread of disease to US bee colonies. At the time the act was passed, Isle of Wight disease (caused by tracheal mites) was ravaging bees in Europe, and Congress wanted to make sure the disease did not enter the United States." (Watanabe, 2008)

Cited literature

Anonymous (1869)
Report of the Commissioner of Agriculture for the year 1868, Statistics of beekeeping, U.S. Government Printing Office pp 272-281. Washington (Report)

Anonymous (1874)
Report of the Commissioner of Agriculture for the year 1872, Report from Iowa, U.S. Government Printing Office pp 479-480. Washington (Report)

Beuhne, R. (1910)
Bee mortality. J. Dept. of Agr. of Victoria, 7, pp 149 - 151

Beuhne, R. (1916)
Bee keeping in Victoria., Department of Agriculture, Victoria Australia pp 149 - 151 Victoria Australia (Report)

Cox-Foster, D., Conlan, S., Holmes, E.C., Palacios, G., Kalkstein, A., Evans, J.D., Moran, N.A., Quan, P.L., Geiser, D., Briese, T., Hornig, M., Hui, J., Vanengelsdorp, D., Pettis, J.S., & Lipkin, W.I. (2008)
The latest buzz about colony collapse disorder - Response. Science, 319, pp 725-725
<Go to ISI>://WOS:000252963000016 AND http://www.botanischergarten.ch/Bees/Anderson-Cox-Foster-Controversy-2008.pdf

Cox-Foster, D. & Vanengelsdorp, D. (2009)
Saving the HONEYBEE, Solving the Mystery of the Vanishing Bees. Scientific American, 300, 4, pp 40-+
<Go to ISI>://WOS:000264456700029 AND http://www.scientificamerican.com/article.cfm?id=saving-the-honeybee&print=true AND http://www.botanischergarten.ch/Bees/Cox-Foster-Solving-the-Mystery1-2009.pdf

Cox-Foster, D.L., Conlan, S., Holmes, E.C., Palacios, G., Evans, J.D., Moran, N.A., Quan, P.-L., Briese, T., Hornig, M., Geiser, D.M., Martinson, V., vanEngelsdorp, D., Kalkstein, A.L., Drysdale, A., Hui, J., Zhai, J., Cui, L., Hutchison, S.K., Simons, J.F., Egholm, M., Pettis, J.S., & Lipkin, W.I. (2007a)
A Metagenomic Survey of Microbes in Honey Bee Colony Collapse Disorder. Science, electronic prepring Science Express, pp 1-4
http://www.sciencemag.org/cgi/content/abstract/1146498v1 AND http://www.botanischergarten.ch/Bees/Cox-Foster-Metagenomic-Survey-2007.pdf

Cox-Foster, D.L., Conlan, S., Holmes, E.C., Palacios, G., Evans, J.D., Moran, N.A., Quan, P.L., Briese, T., Hornig, M., Geiser, D.M., Martinson, V., vanEngelsdorp, D., Kalkstein, A.L., Drysdale, A., Hui, J., Zhai, J.H., Cui, L.W., Hutchison, S.K., Simons, J.F., Egholm, M., Pettis, J.S., & Lipkin, W.I. (2007b)
A metagenomic survey of microbes in honey bee colony collapse disorder. Science, 318, pp 283-287
<Go to ISI>://WOS:000250086100050

Duan, J.J., Marvier, M., Huesing, J., Dively, G., & Huang, Z.Y. (2008)
A Meta-Analysis of Effects of Bt Crops on Honey Bees (Hymenoptera: Apidae). PLoS ONE, 3, 1, pp e1415
http://dx.doi.org/10.1371%2Fjournal.pone.0001415 AND http://www.botanischergarten.ch/Bt/Duan-Meta-Analysis-Effects-Bees-2008.pdf

Foote, L.H. (1966)
The mystery of the disappearing bees. Gleanings in Bee Culture,, 94, pp 152-153

Higes, M., Martin-Hernandez, R., Botias, C., Bailon, E.G., Gonzalez-Porto, A.V., Barrios, L., del Nozal, M.J., Bernal, J.L., Jimenez, J.J., Palencia, P.G., & Meana, A. (2008a)
How natural infection by Nosema ceranae causes honeybee colony collapse. Environmental Microbiology, 10, 10, pp 2659-2669
<Go to ISI>://WOS:000259147900017 AND http://www.botanischergarten.ch/Bees/Higes-Natural-Infection-Nosema-2008.pdf

Higes, M., Martin-Hernandez, R., Garrido-Bailon, E., Botias, C., Garcia-Palencia, P., & Meana, A. (2008b)
Regurgitated pellets of Merops apiaster as fomites of infective Nosema ceranae (Microsporidia) spores. Environmental Microbiology, 10, 5, pp 1374-1379
<Go to ISI>://WOS:000254666700024

Johnson, R. (2007)
Recent Honey Bee Colony Declines, CSR Report for Congress, Order Code RL33938. CSR Report for Congress, Order Code RL33938 pp 13 CSR Report for Congress, Order Code RL33938 Washington (Report)
http://www.botanischergarten.ch/Bees/Johnson-CCD-CRS-2007.pdf

Johnson, R.M., Pollock, H.S., & Berenbaum, M.R. (2009)
Synergistic Interactions Between In-Hive Miticides in Apis mellifera. Journal of Economic Entomology, 102, 2, pp 474-479
<Go to ISI>://WOS:000264899500003

Kauffeld, N.M., Everitt, J.H., & Taylor, E.A. (1976)
Honey bee problems in the Rio Grande Valley of Texas. American Bee Journal, 116, pp 220-222, 232

Kleinschmidt, G. & Kondos, A. (1979)
Colony management for low quality pollens. The Australasian Beekeeper., 81, pp 5-6

Kulincevic, J., Ball, B., & Mladjan, V. (1990)
Viruses in Honey-Bee Colonies Infested with Varroa Jacobsoni - 1st Findings in Yugoslavia. Acta Veterinaria-Beograd, 40, 1, pp 37-42
<Go to ISI>://A1990DB33900006

Kulincevic, J. & Mladjan, V. (1988)
Preventive Treatment of American Foulbrood (Bacillus-Larvae) with Sugar-Oil Antibiotic Patties. Acta Veterinaria-Beograd, 38, 5-6, pp 267-272
<Go to ISI>://A1988T909400008

Kulincevic, J., Stairs, G.R., & Rothenbuhler.Wc (1969)
A Disease of Honey Bee Causing Behavioral Changes and Mortality. Journal of Invertebrate Pathology, 14, 1, pp 13-&
<Go to ISI>://A1969D709100003

Kulincevic, J.M., Rinderer, T.E., & Mladjan, V.J. (1991a)
Effects of Fluvalinate and Amitraz on Bee Lice (Braula-Coeca Nitzsch) in Honey-Bee (Apis-Mellifera L) Colonies in Yugoslavia. Apidologie, 22, 1, pp 43-47
<Go to ISI>://A1991FG51000006

Kulincevic, J.M., Rinderer, T.E., Mladjan, V.J., & Buco, S.M. (1991b)
Control of Varroa-Jacobsoni in Honeybee Colonies in Yugoslavia by Fumigation with Low-Doses of Fluvalinate or Amitraz. Apidologie, 22, 2, pp 147-153
<Go to ISI>://A1991FP08900007

Kulincevic, J.M., Rinderer, T.E., Mladjan, V.J., & Buco, S.M. (1992)
5 Years of Bidirectional Genetic Selection for Honey-Bees Resistant and Susceptible to Varroa-Jacobsoni. Apidologie, 23, 5, pp 443-452
<Go to ISI>://A1992KF90500006

Kulincevic, J.M., Rinderer, T.E., & Urosevic, D.J. (1988)

Seasonality and Colony Variation of Reproducing and Non-Reproducing Varroa-Jacobsoni Females in Western Honey Bee (Apis-Mellifera) Worker Brood. Apidologie, 19, 2, pp 173-179
<Go to ISI>://A1988Q546500007

Kulincevic, J.M., Rothenbuehler, W.C., & Stairs, G.R. (1973)
Effect of Presence of a Queen Upon Outbreak of a Hairless-Black Syndrome in Honey Bee. Journal of Invertebrate Pathology, 21, 3, pp 241-247
<Go to ISI>://A1973P718300004

Kulincevic, J.M. & Rothenbuhler, W.C. (1975)
Selection for Resistance and Susceptibility to Hairless-Black Syndrome in Honeybee. Journal of Invertebrate Pathology, 25, 3, pp 289-295
<Go to ISI>://A1975AC29400003

Kulincevic, J.M. & Rothenbuhler, W.C. (1982)
Selection for Length of Life in the Honeybee (Apis-Mellifera). Apidologie, 13, 4, pp 347-352
<Go to ISI>://A1982QB14100022

Kulincevic, J.M. & Rothenbuhler, W.C. (1989a)
The Effects of Artificial Infection with Chronic Bee Paralysis Virus on Queens from Strains of Honeybee Resistant or Susceptible to Hairless-Black Syndrome. Journal of Apicultural Research, 28, 2, pp 79-80
<Go to ISI>://A1989DD17500004

Kulincevic, J.M. & Rothenbuhler, W.C. (1989b)
Variation in Food Consumed by Caged Worker Bees from Different Colonies. Journal of Apicultural Research, 28, 1, pp 26-29
<Go to ISI>://A1989CV53200004

Kulincevic, J.M., Rothenbuhler, W.C., & Rinderer, T.E. (1982)
Disappearing Disease .1. - Effects of Certain Protein-Sources Given to Honeybee Colonies in Florida. American Bee Journal, 122, 3, pp 189-191
<Go to ISI>://A1982NE81900006 NOT IN NEBIS, NOT IN EZB

Kulincevic, J.M., Rothenbuhler, W.C., & Rinderer, T.E. (1983)
Disappearing Disease .2. Effects of Certain Protein-Sources on Brood Rearing and Length of Life in the Honey Bee under Laboratory Conditions. American Bee Journal, 123, 1, pp 50-53
<Go to ISI>://A1983QA25300010 NOT IN NEBIS, NOT IN EZB

Kulincevic, J.M., Rothenbuhler, W.C., & Rinderer, T.E. (1984)
Disappearing Disease .3. a Comparison of 7 Different Stocks of the Honey Bee (Apis-Mellifera). Ohio Agricultural Research and Development Center Research Bulletin, 1160, pp 1-21
<Go to ISI>://A1984TD14900001 AND http://www.botanischergarten.ch/Bees/Kulincevic-Disappearing-1984.pdf AND https://kb.osu.edu/dspace/handle/1811/24687

Latsch, G. (2007a)
Aids im Bienenstock, Der Spiegel 12 pp 58-59 (Der Spiegel Article)
English: http://www.botanischergarten.ch/Bees/Latsch-CCD-Spiegel-2007.pdf, german: http://www.botanischergarten.ch/Bees/Latsch-Aids-Bienenstock-Spiegel-2007.pdf

Latsch, G. (2007b)
Electronic Source: Are GM Crops Killing Bees? , Der Spiegel Online International
published by: Der Spiegel Online March 22, 2007
Spiegel Online for free:http://www.spiegel.de/international/world/0,1518,473166,00.html

Le Conte, Y. & Navajas, M. (2008a)
Climate change : impact on bee populations and their illnesses. Revue Scientifique Et Technique-Office International Des Epizooties, 27, 2, pp 485-497
<Go to ISI>://WOS:000259353700016

Le Conte, Y. & Navajas, M. (2008b)
Climate change: impact on honey bee populations and diseases. Revue Scientifique Et Technique-Office International Des Epizooties, 27, 2, pp 499-510
<Go to ISI>://WOS:000259353700017 AND http://www.botanischergarten.ch/Bees/Leconte-Climate-Change-Bees-2008.pdf

Maori, E., Lavi, S., Mozes-Koch, R., Gantman, Y., Peretz, Y., Edelbaum, O., Tanne, E., & Sela, I. (2007)
Isolation and characterization of Israeli acute paralysis virus, a dicistrovirus affecting honeybees in Israel: evidence for diversity due to intra- and inter-species recombination. Journal of General Virology, 88, 11/12, pp 3428-3438
<Go to ISI>://WOS:000251619500026 AND http://www.botanischergarten.ch/Bees/Maori-Isolation-Israeli-Acute-2007.pdf

Maori, E., Paldi, N., Shafir, S., Kalev, H., Tsur, E., Glick, E., & Sela, I. (2009)
IAPV, a bee-affecting virus associated with Colony Collapse Disorder can be silenced by dsRNA ingestion. Insect Molecular Biology, 18, 1, pp 55-60
<Go to ISI>://WOS:000262516400006 AND http://www.botanischergarten.ch/Bees/Maori-IAPV-Silenced-2009.pdf

Mayack, C. & Naug, D. (2009)
Energetic stress in the honeybee Apis mellifera from Nosema ceranae infection. Journal of Invertebrate Pathology, 100, 3, pp 185-188
<Go to ISI>://WOS:000264850500007 AND http://www.botanischergarten.ch/Bees/Maycack-Energetic-Stress-Nosema-2009.pdf

McMullan, J.B. & Brown, M.J.F. (2009)
A qualitative model of mortality in honey bee (Apis mellifera) colonies infested with tracheal mites (Acarapis woodi). Experimental and Applied Acarology, 47, 3, pp 225-234
<Go to ISI>://WOS:000262972100005 AND http://www.botanischergarten.ch/Bees/McMullan-Qualitative-Model-Mortality-2009.pdf

Nguyen, B.K., Saegerman, C., Pirard, C., Mignon, J., Widart, J., Tuirionet, B., Verheggen, F.J., Berkvens, D., De Pauw, E., & Haubruge, E. (2009)
Does Imidacloprid Seed-Treated Maize Have an Impact on Honey Bee Mortality? Journal of Economic Entomology, 102, 2, pp 616-623
<Go to ISI>://WOS:000264899500021 AND http://www.botanischergarten.ch/Bees/Nguyen-Imidacloprid-Seed-2009.pdf

Oertel, E. (1965)
Many bee colonies dead of an unknown cause. American Bee Journal, 105, pp 48-49

Pajuelo, A.G., Torres, C., & Bermejo, F.J.O. (2008)
Colony losses: a double blind trial on the influence of supplementary protein nutrition and preventative treatment with fumagillin against Nosema ceranae. Journal of Apicultural Research, 47, 1, pp 84-86
<Go to ISI>://WOS:000254014000014 AND http://www.botanischergarten.ch/Bees/Pajuelo-Colony-Losses-2008.pdf

Palacios, G., Hui, J., Quan, P.L., Kalkstein, A., Honkavuori, K.S., Bussetti, A.V., Conlan, S., Evans, J., Chen, Y.P., vanEngelsdorp, D., Efrat, H., Pettis, J., Cox-Foster, D., Holmes, E.C., Briese, T., & Lipkin, W.I. (2008)
Genetic analysis of Israel acute paralysis virus: Distinct clusters are circulating in the United States. Journal of Virology, 82, 13, pp 6209-6217
<Go to ISI>://WOS:000256947300012 AND http://www.botanischergarten.ch/Bees/Palacios-Genetic-Analysis-2008.pdf

Ramirez-Romero, R., Desneux, N., A., D., Chaffiol, A., & Pham-Delegue, M.H. (2008)
Does Cry1Ab protein affect learning performances of the honey bee Apis mellifera L. (Hymenoptera, Apidae)? Ecotoxicology and Environmental Safety, In Press, Corrected Proof, pp
http://www.sciencedirect.com/science/article/B6WDM-4RWK072-2/2/123e7dfc2ecddadee7da81bca89cc97e AND http://www.botanischergarten.ch/Bt/Ramirez-Romero-Affect-Bees-2008.pdf

Ribiere, M., Olivier, V., Blanchard, P., Schurr, F., Celle, O., Drajnudel, P., Faucon, J.P., Thiery, R., & Chauzat, M.P. (2008)

The collapse of bee colonies: the CCD case ("Colony collapse disorder") and the IAPV virus (Israeli acute paralysis virus). Virologie, 12, 5, pp 319-322
<Go to ISI>://WOS:000262852300001 AND http://www.botanischergarten.ch/Bees/Ribiere-CCD-Virologie-2008.pdf

Sanford, M.T. (1987)
Diseases and Pests of the Honey Bee, Entomology and Nematology Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida CIR766 pp 16 (Report)
http://edis.ifas.ufl.edu/BODY_AA090#FOOTNOTE_1 AND http://www.botanischergarten.ch/Bees/Sanford-Diseases-1987.pdf

Sanford, M.T. (2007)
Colony Collapse Disorder (CCD), an update. Bee Culture, May, pp 17-19
http://www.beeculture.com/storycms/index.cfm?cat=Story&recordID=541 AND
http://www.botanischergarten.ch/Bees/Sanford-Insecticides-CCD-2007.pdf

Savoy, A.C., Lupan, D.M., Manalo, P.B., Roberts, J.S., Schlageter, A.M., Weinhold, L.C., & Kozel, T.R. (1997)
Acute lethal toxicity following passive immunization for treatment of murine cryptococcosis. Infection and Immunity, 65, 5, pp 1800-1807
<Go to ISI>://WOS:A1997WW39800033

Stokstad, E. (2007a)
ENTOMOLOGY: The Case of the Empty Hives. Science %R 10.1126/science.316.5827.970, 316, 5827, pp 970-972
http://www.sciencemag.org/cgi/content/summary/316/5827/970 AND subscribers
http://www.botanischergarten.ch/Bees/Stockstad-Empty-2007.pdf

Stokstad, E. (2007b)
GENOMICS: Puzzling Decline of U.S. Bees Linked to Virus From Australia. Science %R 10.1126/science.317.5843.1304, 317, 5843, pp 1304-1305
http://www.sciencemag.org AND http://www.botanischergarten.ch/Bees/Stockstad-IAPV-Culprit-2007.pdf

Teixeira, E.W., Chen, Y.P., Message, D., Pettis, J., & Evans, J.D. (2008)
Virus infections in Brazilian honey bees. Journal of Invertebrate Pathology, 99, 1, pp 117-119
<Go to ISI>://WOS:000259131400018 AND http://www.botanischergarten.ch/Bees/Weinstein-Teixeira-Virus-Brazil-2008.pdf

Tew, J.E. (2002)
Bee Culture's Beeyard. In ECAI 2002. 15th European Conference on Artificial Intelligence Proceedings. Dr. James E. Tew, State Specialist, Beekeeping, The Ohio State University, Wooster, OH 44691
http://www.orsba.org/htdocs/download/Dtew.htm AND http://www.botanischergarten.ch/Bees/Tew-Bee-Cultures-Beeyard-2002.PDF

Van Engelsdorp, D., Evans, J.D., Donovall, L., Mullin, C., Frazier, M., Frazier, J., Tarpy, D.R., Hayes, J., & Pettis, J.S. (2009)
"Entombed Pollen": A new condition in honey bee colonies associated with increased risk of colony mortality. Journal of Invertebrate Pathology, 101, 2, pp 147-149
<Go to ISI>://WOS:000267382800012 AND http://www.botanischergarten.ch/Bees/VanEngelsdorp-Entombed-Pollen-2009.pdf

van Engelsdorp, D., Foster, D.C., Frazier, M., Ostiguy, N., & Hayes, J. (2006)
Electronic Source: “Fall-Dwindle Disease”: Investigations into the causes of sudden and alarming colony losses experienced by beekeepers in the fall of 2006. Preliminary Report: First Revision, CCD Working Group Preliminary Report
published by: Bee Alert Inc., Florida Dept. of Agriculture, Pennsylvania State University, Pennsylvania Dept. of Agriculture, USDA/ARS, 22pp
http://www.botanischergarten.ch/Bees/vanEngelsdorp-CCD-working-group-Update-2007.pdf AND
http://www.doacs.state.fl.us/pi/plantinsp/apiary/fall_dwindle_report.pdf

van Engelsdorp, D., Hayes, J., Jr., Underwood, R.M., & Pettis, J. (2008)
A Survey of Honey Bee Colony Losses in the US, Fall 2007 to Spring 2008. PLoS ONE, 3, 12, pp Article No.: e4071

<Go to ISI>://BIOSIS:PREV200900336218 AND http://www.botanischergarten.ch/Bees/vanEngelsdorp-Survey-Colony-Losses-2008.pdf

Watanabe, M.E. (2008)
Colony collapse disorder: Many suspects, no smoking gun. Bioscience, 58, 5, pp 384-388
<Go to ISI>://WOS:000255971600005 AND http://www.botanischergarten.ch/Bees/Watanabe-CCD-Many-Suspects-2008.pdf

Williams, J.L. & Kauffeld, N.M. (1974)
Winter conditions in commercial colonies in Louisiana. 114, pp 219-221

Wilson, W.T. & Menapace, D.M. (1979)
Disappearing disease of honey bees: A survey of the United States. American Bee Journal, 119, Part I and Part II, pp 118-119 and 184-186, 217