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BRIEFING DOCUMENT

PRESERVING THE WELLBEING OF THE HONEY BEE

Summary

For some years, noticeable bee colony losses have been observed in many parts of the world, well in excess of the range of losses that is considered normal. Bee experts and registration authorities globally have concluded that these losses are due to a variety of causes, sometimes interrelated, including bee diseases, parasite infestation (particularly by the Varroa mite), unfavourable environmental and climatic conditions, as well as agricultural and apicultural practices. Poor bee nutrition, mass bee transportation over long distances, and poor bee husbandry are also likely to be contributing to higher colony losses. A wide body of studies and investigations by scientific institutes and official bodies has found no scientifically founded causal link between any single pesticide or biotech crop.

All of the research to date indicates that no single cause is responsible for the colony losses we are seeing worldwide, as confirmed by the majority of bee researchers worldwide and, amongst others, the World Organisation for Animal Health (OIE), the European Food Safety Agency (EFSA) and the International Bee Research Association (IBRA).

The contemporary challenge for all those concerned about the plight of the honey bee is to ensure that we acquire the knowledge and means to protect this essential, beneficial insect. Current gaps in scientific understanding of colony losses need to be bridged and new, more collaborative ways of managing the problem globally need to be developed, encompassing the interaction between the beekeeping and agricultural sectors.

Bee pollination services are key to assuring agricultural production. Therefore, the plant science industry has a natural interest in working to preserve the health of bees and fully supports further research into the multiple causes of the problem.

History

The loss of honey bees and their colonies is not uncommon and has been observed over many years and in many different countries. Honey bees, like all living organisms in a dynamic system, are vulnerable to diseases and environmental changes and have historically always suffered losses from time to time. Reports of such colony losses date back to the 19th century. Some of these losses have baffled beekeepers and farmers for centuries and continue to perplex researchers today.

The *Varroa* mite, generally considered to be the main threat to honey bee colonies

today, is a parasite that was first found on honey bees in the 1950s. By the 1970s it had spread from the far eastern USSR to central Europe, causing extensive colony losses. It has since spread globally, affecting colonies in all countries except Australia.

Another significant parasite, *Nosema ceranae*, was first observed in honey bee colonies in China in 1994. Whilst linked especially with poor bee health in Spain from 2004, it has also been prevalent in France and Germany since 2006, in the United Kingdom since 2008, and in many other European countries since then.

Honey bee colonies have also been affected by a phenomenon dubbed "Colony Collapse Disorder" (CCD). In late 2006, beekeepers in the United States began observing the mysterious loss of hundreds of thousands of bee colonies. Scientists cannot attribute these losses to any particular parasite, pest, pathogen or other single, definable cause.

FAQs

What are colony losses?

- Just as individual honey bees naturally succumb to a variety of life-threatening stressors, entire bee colonies can also perish. Colonies are regularly lost all over the world as a result of a wide range of diseases and environmental factors, with no single cause being principally responsible for all colonies lost, as confirmed amongst others by the World Organisation for Animal Health (OIE), the European Food Safety Agency (EFSA) and the International Bee Research Association (IBRA).

- Since autumn 2006, beekeepers in the USA have reported a mysterious mass mortality among honey bees. At this time, the symptoms observed cannot be ascribed to any particular cause or to any particular pathogen. Colonies experiencing a collapse rapidly lose most of their adult bees, which leave the hives in order to die elsewhere. The few remaining bees show an unusual spectrum of bacterial and viral infections, or even parasite infestation and fungal diseases. Bee researchers in the U.S. have coined the term Colony Collapse Disorder (CCD) to describe this phenomenon.

- Not all colony losses can be described as Colony Collapse Disorder (CCD). The term "colony losses" describes the death of bee colonies, irrespective of the causes or specific symptoms, whereas CCD is a clearly defined syndrome with specific symptoms.

What are the major known causes of colony losses?

- *Varroa destructor*

  The honey bee mite, Varroa destructor, remains the greatest threat to apiculture today.

  Varroa-induced disease, or 'varroosis', is caused by this parasitic bee mite. Varroa mites are external honeybee parasites that attack both the adults and the

brood, weakening and shortening the life span of the bees on which they feed. Infested brood may be deformed with missing legs or wings. Untreated infestations of varroa mites may ultimately kill honeybee colonies. Losses due to these parasitic mites are often confused with other causes, such as weather related winter mortality and "queenlessness".

Varroosis treatment depends heavily on a small portfolio of varroacides to the most of which, unfortunately, resistance has already been reported. Beekeepers and authorities are consequently concerned about the availability of veterinary products for bees.

Varroa destructor is a relatively new parasite of the honey bee and has spread to most areas of the world within a short time period and it is now difficult to find a "varroa-free" honey bee colony, other than in Australia, where the mite does not yet occur.

At a global scale, most managed bee colonies are infested by Varroa destructor. Moreover, many other prominent honey bee pathogens can now be found around the world, such as *Nosema ssp*, and several viruses and bacteria.

- *Nosema ceranae*

  Nosema ceranae is a microsporidian parasite, invisible to the naked eye, that invades the immune and digestive systems of honey bees. It can seriously weaken and ultimately kill worker bees, as well as affect the capacity of nurse bees to feed larvae. Honey production in these hives is often greatly reduced, as is the bees' ability to resist unfavorable environmental conditions. The prevalence of this parasite in honey bee colonies follows a strong seasonal pattern, with most outbreaks occurring in the spring. *Nosema ceranae* is found in North and South America, the Caribbean, Asia and right across Europe. There is currently no universally effective treatment.

- *Vespa velutina*

  The *Vespa velutina* is a hornet native to China, which has been invading increasing numbers of hives in Europe, further damaging colonies already weakened by parasites like *Varroa destructor* and *Nosema ceranae*. These hornets are astonishingly efficient predators; two or three of them working together can destroy an entire hive very quickly. Nesting high off the ground in the treetops and having no natural predator, the *Vespa velutina* is particularly difficult to control. Currently it is a threat restricted to some parts of Europe only.

- *Other pathogens*

  Another parasite that can be a destructive pest in honey bee colonies is the Small Hive Beetle (SHB, *Aethina tumida*). The Small Hive Beetle is indigenous to Africa, where it is considered a minor pest of honey bees, and was long thought to be restricted to this region and a handful of other countries. However, in 1998, this pest was detected in Florida and it is now widespread throughout the USA. The Small Hive Beetle is a major threat to the long-term sustainability and economic prosperity of beekeeping in many areas, including the European Union (EU).

  Among honey bee pathogens, viruses are one of the most significant threats to the health and well-being of honey bees and cause serious concern for researchers and beekeepers.

Although bee viruses usually persist as unapparent infections and cause no overt signs of disease, they can dramatically affect honey bee health and shorten the lives of infected bees under certain conditions, such as infestation of varroa mites, co-infection of other pathogens such as *N. apis*, or a decline in food supply. Some of the more common viruses that infect honey bee colonies include: Deformed Wing Virus (DWV), Sacbrood Virus (SBV), Black Queen Cell Virus (BQCV), Kashmir Bee Virus (KBV) and Acute Bee Paralysis Virus (ABPV). Significant correlations between winter mortality of honey bee colonies and the viruses ABPV and DWV (both associated with *Varroa destructor*) have been found. In the USA, infections with Israeli acute paralysis virus (IAPV) have been reported to be associated with Colony Collapse Disorder (CCD).

The most relevant bacterial diseases are American Foulbrood (AFB) and European Foulbrood (EFB). American Foulbrood (AFB), caused by the bacterium *Paenibacillus larvae ssp.* larvae, is the most widespread and destructive of the bee brood diseases. This disease only affects the bee larvae but is highly infectious and diseased colonies usually die. *Melissococcus plutonius* is a bacterium that causes European Foulbrood (EFB). European Foulbrood is less deadly to a colony than American Foulbrood and often considered rather as a "stress" disease—a disease that is dangerous only if the colony is already under stress for other reasons.

- Colony Collapse Disorder (CCD)

  Vast numbers of colonies have died as a result of the phenomenon referred to as "Colony Collapse Disorder" (CCD) in the United States. The honey bees quickly abandon their hives, leave them to die and do not return. Scientists cannot attribute these losses to any particular parasite, pest, pathogen or other single, definable cause. It is a clearly defined syndrome with specific symptoms, rather than a cause of bee mortalities. However, only about 26% of all the cases of higher bee mortality reported in the USA in 2009 are connected with this phenomenon. In 2009, beekeepers ranked CCD in eighth place among the suspected causes of bee deaths.

- Environmental factors

  - Poor bee nutrition — Honey bees, like all pollinating insects, need plentiful forage sources such as flowers, shrubs and hedgerows to obtain the pollen that is essential for their growth and development. Poor environmental stewardship can lead to habitat loss, which results in poor bee nutrition.
  - Extreme climate conditions — Honey bees are naturally sensitive to the weather and their productivity and wellbeing are partly dependant on a favorable climate. Unusual climactic conditions can affect nectar flows.
  - Mass bee transportation — For certain crops, farmers and growers need to ensure pollination by commissioning honey bee colonies, often from far afield. Such colonies can be subject to migratory stress and more exposed to disease as a result of repeated transportation.
  - Poor bee husbandry — The quality of the bee colony can be affected by the ways in which beekeepers look after them. Varroa mite management is a particular challenge. The irresponsible use of unregulated apicultural products is an example of poor bee husbandry. Assuring sufficient feed is another key factor for bee health.

Is the use of pesticides or biotechnology in agriculture responsible for colony losses?

- The plant science industry conducts in-depth research into the characteristics of both pesticides and biotech crops from an early stage to ensure that they do not negatively impact non-target species like the honey bee. Very stringent regulatory safeguards are in place to ensure that no products or crops posing an unacceptable risk to plant or animal life are allowed on the market. For example, a new pesticide takes on average almost 10 years to research and develop, typically requiring over 120 separate studies before gaining approval to go on the market. While already very stringent, testing regimes are continually being refined and improved.

- Pesticides take on average almost ten years to research and develop. During that time, laboratory and field studies studies are conducted to assure bee health. Whilst there are laboratory studies that show effects of some insecticides on bees, subsequent field studies, using real situations with real bee colonies and real beekeepers, revealed that those insecticides pose no hazard to bees when appropriate stewardship measures are applied. It goes without saying that insecticides should be applied in strict accordance with the label requirements and according to good agriculture practice and Integrated Pest Management (IPM) principles.

- There is currently no scientific evidence that any single pesticide or biotech crop, when used responsibly and according to the label, is causing colony losses. Agriculture is a dynamic system in which all living organisms, including honey bees, are subject to a range of stressors. All of the research to date indicates that no single cause is responsible for the colony losses we are seeing worldwide, as confirmed by the World Organisation for Animal Health (OIE), the European Food Safety Agency (EFSA) and the International Bee Research Association (IBRA).

What can be done to improve and enhance bee health?

- Effective action to tackle bee colony losses requires collaboration among the various stakeholders, including government, scientists, bee keeping community and the food and agriculture industries. Collaborative partnerships between beekeepers and farmers are a key part of the solution.

- Further scientific research is needed to identify appropriate solutions to all the relevant factors negatively impacting on bee health.

- Knowledge transfer needs to be optimized to ensure that beekeepers have access to knowledge on best practice in bee husbandry.

For more information

- French Food Safety Agency (AFSSA). "Weakening, collapse and mortality of bee colonies" (February 2009) http://www.afssa.fr/Documents/SANT-Ra-MortaliteAbeillesEN.pdf

- Dennis van Engelsdorp, Jerry Hayes Jr, Robyn M Underwood and Jeffery S Pettis. "A survey of honey bee colony losses in the United States, fall 2008 to spring

2009" in Journal of Apicultural Research 49(1): 7-14 (2010)
http://www.ibra.org.uk/articles/20091221_31

- Reed M. Johnson, Marion D. Ellis, Christopher A. Mullin, Maryann Frazier. "Pesticides and honey bee toxicity – USA" in Apidologie, INRA/DIB-AGIB/EDP Sciences (12 April 2010)
http://www.apidologie.org/index.php?option=article&access=doi&doi=10.1051/apido/2010018

- May R. Berenbaum et al, University of Illinois. "Changes in transcript abundance relating to colony collapse disorder in honey bees" in Proceedings of the National Academy of Sciences, vol. 106, no. 35, (1 Sept, 2009).
http://www.pnas.org/content/106/35/14790.full.pdf+html

- CCD Steering Committee. "Colony Collapse Disorder Progress Report" (June 2009)
http://www.ars.usda.gov/is/br/ccd/ccd_progressreport.pdf

- International Bee Research Association (IBRA). "Special Issue: Colony Losses" in Journal of Apicultural Research, Vol. 49, No. 1 (January 2010)
http://www.ibra.org.uk/articles/specialissue2010

- European Food Safety Authority (EFSA). "Scientific Report on Bee Mortality and Bee Surveillance in Europe" (December 2009)
http://www.efsa.europa.eu/EFSA/efsa_locale1178620753820_1211902584688.htm

- Dennis van Engelsdorp, Marina D. Meixner. "A historical review of managed honey bee populations in Europe and the United States and the factors that may affect them" in Journal of Invertebrate Pathology (February 2010)
http://www.elsevier.com/locate/yjipa

- The World Organisation for Animal Health (OIE). "Health problems of bees are due to multiple factors" (28 April 2010)
http://www.oie.int/eng/press/en_100428.htm
- Food and Agriculture Organization of the United Nations (FAO). FAO ProdSTAT Database (2009)
http://faostat.fao.org/default.aspx

- CropLife International. "Integrated Pest Management
http://www.croplife.org/public/ipm

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