

Colony Collapse Disorder (CCD) Working Group: Summary of purpose and responsibility

January 17, 2007

During 2006, an alarming number of honey bee colonies began to die across the continental United States. Subsequent investigations suggest these outbreaks of unexplained colony collapse were experienced by beekeepers for at least the last two years. Reports of similar die offs are documented in beekeeping literature, with outbreaks possibly occurring as long ago as 1896. The current phenomenon, without a recognizable underlying cause, has been tentatively termed “Colony Collapse Disorder” (CCD), and threatens the pollination industry and production of commercial honey in the United States. Initial studies on bee colonies experiencing the die offs has revealed a large number of disease organisms present in the dying colonies, with most being “stress related” diseases and without any one disease being supported as the “culprit” underlying the deaths. The magnitude of detected infectious agents in the adult bees suggests some type of immunosuppression. Case studies and questionnaires related to management practices and environmental factors have identified a few common factors shared by those beekeepers experiencing the CCD; but no common environmental agents or chemicals were easily identified by these surveys. The search for underlying causes has been narrowed by the preliminary studies, but several questions remain to be answered.

To better understand the cause(s) of this disease and with the hope of eventually identifying strategies to prevent further losses, a group of researchers, extension agents, and regulatory officials was formed. This group represents a diverse number of institutions including Bee Alert Technology, Inc. (a bee technology transfer company affiliated with the University of Montana), The Pennsylvania State University, the USDA/ARS, the Florida Department of Agriculture, and the Pennsylvania Department of Agriculture.

Broadly this group has identified its mandate as: “Exploring the cause or causes of honey bee colony collapse and finding appropriate strategies to reduce colony loss in the future”.

In order to maximize limited resources, most efficiently utilize our various expertise, and deliver timely summary of our findings and thoughts, this CCD working group has agreed to:

- 1) Share all communication regarding our investigations into CCD with one another.
- 2) Establish standardized sampling protocols and collect samples for all CCD working group members whenever feasible.
- 3) Clearly define areas of responsibility and research effort
- 4) Share results of analyses with the entire working group for discussion and integration
- 5) Regularly distribute summary reports to the bee keeping community
- 6) Work together to secure emergency funding and future sustainable funding to investigate the causes of the CCD and treatments to prevent CCD
- 7) Deliver by meetings, reports, and publications the findings of the groups to beekeepers and appropriate scientific audiences
- 8) Develop an agreement on how involvement in the research will be appropriately acknowledged and cited in any oral or written presentation of the research, in order to circumvent any misunderstandings among the members and maximize the likelihood of finding answers to aid beekeepers and the health of the pollination industry.

The responsibility/efforts of the CCD working group is as follows (and in no particular order):

Jerry Bromenshenk (Bee Alert Technology, Inc.)

- Assist in coordination of overall research efforts
- Organize acoustic and vapor sampling of healthy and affected colonies
- Coordinate field sampling at the national level
- Interview investigators involved with early appearances of this disorder (i.e., 60s-70s)
- Maintain contact with industry personal, as well as the support industries, interested parties

Garon Smith (Bee Alert Technology, Inc.)

- Conduct analyses of environmental chemicals in hive atmospheres (such as HMF from corn syrup, legal and illegal compounds used for mite control)
- Examine feasibility of detecting toxin made by *Aspergillus*.

Robert Seccomb (Bee Alert Technology, Inc.)

- Provide and maintain the web-accessible, geospatial database that summarizes where bee losses have occurred, with links to Google Earth and client access to all members of the research group
- Design and apply pattern-recognizing software, Artificial Neural Networks, for acoustic sonogram analysis.

Larry Tarver (Bee Alert Technology, Inc.)

- Develop and maintain online national bee loss survey/ questionnaire of bee keepers
- Engineer/provide software to allow access to the surveys by the CCD Working Group
- Provide and maintain, with Robert Seccomb, the web-accessible database that summarizes sampling protocols, and research results
- Design and apply analysis software for acoustic sonogram analysis.

Colin Henderson (Bee Alert Technology, Inc.)

- Provide guidance for epidemiology and other experimental designs
- Assist in development of field sampling protocols appropriate for multi-variate and geo-spatial analysis of landscape/regional/national dispersion of the CCD
- Conduct appropriate statistical analysis

Steven Rice/Dave Plummer/Ted Etter (Bee Alert Technology, Inc.)

- Design and prototype electronic systems for acoustic sampling, bi-directional bee counters, and other electronics as needed

Scott Debnam (Bee Alert Technology, Inc.)

- Primary field technician
- Conduct follow up surveys with beekeepers to ensure completeness, clarify responses.

Dennis vanEngelsdorp (Penn State/PA Department of Agriculture)

- continue detailed case study histories of select beekeepers
- internal pathology/gut contents and protozoa/flagellates
- perform literature review on previous reports of similar colony die offs and disease symptoms in bees (with Dr. Robyn Underwood)
- assist in the coordination of research efforts

- assist in communication with bee keepers/ bee list servers

Jerry Hayes (Florida Department of Agriculture)

- assist in identifying disease outbreak
- assist in the coordination of research efforts
- assist in communication with bee keepers/ bee list servers

Diana Cox-Foster (Penn State)

- unknown pathogen determination
- internal pathology/gut contents and protozoa/flagellates
- pathology in bees
- fungal characterization
- Examine equipment re-use strategies (with USDA/ARS)

David Geiser (Penn State)

- fungal characterization (with Diana Cox-Foster)

Maryann Frazier (Penn State)

- neonicotinoid insecticide and fungicide residues in colony food stores, brood and adult bees
- assist in communication with bee keepers/ bee list servers

Nancy Ostiguy (Penn State)

- assist in the coordination of research efforts
- examine equipment reuse (with USDA/ARS)
- conduct epidemiological review
- conduct case-histories (with Dennis vanEnglesdorp)
- coordinate/perform statistical analyses

Jeff Pettis - with Jay Evans and Judy Chen— (USDA/ARS)

- characterize known honey bee Viruses, bacterial disease, chalkbrood using microarray analysis
- quantify varroa mite, HBTM characterize and Nosema
- refine detection methods for Nosema
- Examine equipment re-use strategies with Penn State

David Tarpy – North Carolina State University

- quantify whole-bee protein levels as a proxy for nutritional stress
- use genetic paternity analyses to determine if levels of intracolony diversity are correlated with CCD incidence and magnitude
- employ mitotyping analyses to determine CCD rates between different races of honey bee (Eastern vs. Western European origin)
- develop possible new qRT-PCR protocols to quantify relative levels of parasite infestations (nosema and/or tracheal mites)

Members of the CCD working group, meet by conference call on January 17, 2007.

At this meeting they defined the symptoms of CCD as follows:

- 1) In collapsed colonies
 - a. The complete absence of adult bees in colonies, with no or little build up of dead bees in the colonies or in front of those colonies.
 - b. The presence of capped brood in colonies,
 - c. The presence of food stores, both honey and bee bread
 - i. which is not robbed by other bees
 - ii. when attacked by hive pests such as wax moth and small hive beetle, the attack is noticeably delayed.
- 2) In cases where the colony appear to be actively collapsing
 - a. An insufficient workforce to maintain the brood that is present
 - b. The workforce seems to be made up of young adult bees
 - c. The queen is present
 - d. The cluster is reluctant to consume provided feed, such as sugar syrup and protein supplement

The CCD working group identified the following as requiring immediate attention:

- 1) Establishment of sampling protocols
 - a. Each participant will develop a sampling and storage protocol for their specific needs and will distribute to the group
- 2) Sample both colonies suffering from the onset of CCD as well as colonies not suffering from CCD in as wide a geographic range as possible
- 3) Perform exploratory sample analysis on a sub set of these samples to identify future direction
- 4) Identification of emergency funding sources to permit item 2 and 3 above