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Special Issue on Bee Health

In recent years, the large-scale loss of honey bee colonies has come into focus under a world-wide spotlight. Colony collapse disorder, winter losses and weak bee colonies are pervasive in many apiaries leading to a very serious situation for beekeepers and pollination. Poor colony health has generated concern among scientists and funding agencies, which, fortunately, is resulting on substantial new scientific research on honey bee pathology. We thought it would be timely to compile a Special Issue on honey bee health to help synthesize information current research on this subject.

We begin with three reviews on the status of bee health in the US, in Europe, and in Latin America. The review by J. Pettis and K. Delaplane highlights the massive research efforts underway in the US, funded by two branches of the US Department of Agriculture. The review by Moritz et al. highlights the equally rigorous research plans coordinated across Europe. Until now, the bee health situation in Latin America has not been well documented. R. Vandame and A. Palacio contrast bee genetics, agricultural practices and landscape use in Latin American with more industrialized countries, and present hypotheses for the “fragile equilibrium” that bees are experiencing in southern hemisphere of the New World. Knowing the scope of studies being conducted in these regions may help readers focus and coordinate further research efforts across the world.

The next group of articles review environmental impacts on bee health: the effects of landscapes, nutrition, propolis use, and pesticides. Landscapes and environmental policy issues, discussed by N. Desneux et al., clearly affect the floral resources available to bees, which in turn affects bee nutritional state, as reviewed by R. Brodschneider and K. Crailsheim. Much attention is rightly being focused on the abundance and quality of pollen available to bees throughout the year, and how pollen nutrition impacts bee immune responses, susceptibility to disease, and colony population. Pesticide use, discussed by R. Johnson et al., can have direct and lethal effects on bees. But emerging research is showing that the sublethal and synergistic effects of pesticides may be posing hidden but severe risks to bees. In addition, the combined effects of pesticides, poor nutrition, and diseases may further compound the burden facing bees foraging in our modern agricultural and urban environment. It is becoming clear that the immune system of bees is being taxed in unprecedented ways. A review of prior and current research on propolis by M. Simone and M. Spivak provides insight on the benefits of this often overlooked but important antimicrobial substance to the social immunity of bee colonies.

A series of articles on pathogens and parasites of bees provide new and very interesting data. An amazingly comprehensive survey of bee health in Germany, reviewed by E. Genersch et al., concludes that *Varroa destructor* is likely the root cause of bee losses in that country. Backing this conclusion, Y. Le Conte et al. review the impact of *Varroa* on honey bees and present a cogent argument for more research attention to these mites. Future plans to sequence the *Varroa* genome will present a new avenue for research on the mite, and will highlight the *Varroa* – honey bee relationship as one of the most interesting host parasite models to study. The impact of *Nosema*

ceranae on bee health in the U.S. and Asia, and in Europe, is reviewed by J. Chen and Z. Huang, and by M. Higes et al., respectively. The widespread occurrence of this new species of *Nosema* took most researchers by surprise in recent years. It is important to understand how this disease of adult bees affects bees on its own, and in combination with the multitude of other pathogens, parasites and environmental stressors on bees.

Finally, we present two review articles on bee breeding and natural selection for bee resistance to parasites and pathogens. A number of research and beekeeping selection programs in Europe have resulted in local populations of bee colonies that are surviving without treatments for mites. Büchler et al. review the concerted efforts underway in Europe to select for specific traits, such as hygienic behavior, that help bees reduce mite loads. They also review the various successes of other efforts such as the “Live and Let Die” approach to bee breeding. Rinderer et al., review the successes of two main bee breeding efforts undertaken in the US. The first is the Russian bee project; bees that were imported from far eastern Russia that show good resistance to *Varroa* across the US, especially in colonies that are maintained in one location year round. The second is the line of bees bred within the US called the VSH line for “*Varroa* Sensitive Hygiene”. These bees display a heightened expression of hygienic behavior toward mites, and also show demonstrable resistance to the mites.

We are deeply concerned about the losses of honey bee colonies in the US and in Europe. We are proud to present this Special Issue on Bee Health, which involves many prominent scientists in the field. Thanks to all the authors for their great cooperation in this long process. We hope the articles in this issue provide impetus for more research on ways to ameliorate colony loss and promote bee health.

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