Bulletin UASVM Animal Science and Biotechnologies, 68(1-2)/2011
Print ISSN 1843-5262; Electronic ISSN 1843-536X

Disease and Behavior in Honeybees

Bogdan I. GHERMAN[1), Liviu Al. MĂRGHITAŞ[1),
Daniel S. DEZMIREAN[1), Robin F.A. Moritz[2)

[1)]University of Agricultural Sciences and Veterinary Medicine, 3-5 Mănăştur Street, 400372 Cluj-Napoca, Romania; bogdan.gherman74@yahoo.com
[2)]Martin Luther Universität Halle Wittenberg, Germany

Abstract. This brief review is mend to present a better idea about the changes of honeybee behavior when certain diseases occur. Lately, massive colony losses have been reported and previous studies proved that not only single disease can destroy a colony, but multiple factors can have a huge impact on the beekeeping industry. This brief review will help to understand better what is to do in the near future in order to avoid losses of colonies of this social insect, the honeybee *Apis mellifera*. It is very important to have alternatives to traditional treatments of diseases (many chemical substances that we find in medical treatment have been forbidden not only in the EU, but also in many other countries) and to get some answers in order to defeat the threat of industry breakdown due to poorer bee pollination.

Keywords: importance of honeybees, pollination, bee products, hygienic behavior, *Nosema ceranae*, *Varroa destructor*, AFB

INTRODUCTION

It is very well known the importance of honeybee *Apis mellifera*, due to the activities that she performs or to the products that we obtain from. Thank to the biological particularities of the honeybee, they provide a large range of products, well appreciated since a long time before. The supplementary crossed-selective pollination of plants is very useful to obtain better and superior quality crops (Mărghitaş, 2002).

Being a social insect, the honeybee lives in large groups that have a lot more benefits if it is compared to solitary lifestyle. Cooperation between group members can increase the efficiency of brood care, foraging, or anti-predator defenses. All the benefits that come from working together are considered to be the main reasons why, for example, social insects have become dominant species in various habitats. Living in social groups also has some negative aspects as: infectious diseases can be spread more easily between group members, as compared with solitary life style (Cremer, 2007).

The reasons for that are, in the first place, transmission is easier to happen when individuals live at relatively high densities and have frequent social contact and, secondly, that group members are often close relatives and thus susceptible to the same parasite infections.

Also, it is expected that social groups offer particularly favorable conditions for the spread of infectious diseases. As a response, the groups have also developed several tactics to defeat this threat. Primates and social insects have, in parallel, evolved sophisticated collective anti-parasite defenses, for example, all grooming behavior to remove parasites from group members. These defenses can be prophylactic, such as the intake of propolis by honeybees to prevent fungal and bacterial growth or to cover any possible nest cracks. Other defenses are activated as needed, for example, social fever in honeybees, when many bees raise their body temperature in the same time to heat-kill bacteria in their hive (Cremer, 2007).

A common factor of these social defenses is that they are based on collective action or altruistic behavior of infected individuals that benefit the colony. These defenses therefore depend on the cooperation of social group members resulting in avoidance, control or elimination of parasitic infections -phenomena that we summarize as parts of a 'social immune system'. The individual members of an insect society cooperate to ensure colony growth, survival and reproduction. There is reproductive division of labor such that one or a few individuals, the queens and their mates, produce the colony offspring, while the majority of individuals, the workers, perform tasks such as foraging, nest construction and maintenance, and caring for offspring (Cremer, 2009).

The dependence of the colony upon one or a few reproductive individuals means that the fitness of all members of the society is jeopardized when the queen dies because of an infection.

Also, there is a transfer of benefits hypothesis, which suggests that females mate with multiple males to accumulate fitness-enhancing resources provided by males (Crozier, 2001).

How do they defend themselves? The term of 'defend' is known very well and also very used, being the right word for the behavior of the honeybee. We shall try to explain what they do in case of a disease, what we know and what there is to know.

One of the most destructive diseases that honeybees have to fight with is American Foulbrood (AFB), caused by *Paenibacillus larvae (P.larvae)*. This pathogen agent has a very high resistance (20-40 years), depending on the environmental conditions (Mărghitaş, 2002). The contamination occurs by feeding the larvae, starting in the 2nd day, when the bees feed the brood. The main sources of infection are the dried dead larvae, which are removed by the bees. This behavior is very much relevant to what we know about social insects' behavior, but is also a disease-spreading behavior, because, by cleaning the cells, they spread the spores all over the hive. The bees remove the dead larvae from the cells, clean the cells in order to make room for the queen to lay eggs. Therefore, the eggs are not homogenously spread in the comb, which might be dangerous for the colony strength (Mărghitaş, 2002).

The *Varroa* mite, *Varroa destructor*, is recognized as the most serious pest of both managed and feral honeybees (*Apis mellifera*) in the world. The mite has developed resistance to fluvalinate, an acaricide used to control it in beehives, and fluvalinate residues have been found in the beeswax, triggering an urgent need to find alternative control measures to suppress this pest. During infestation, especially in winter, bees have the instinct to consume more food, in order to have more strength to fight with the disease, unfortunately this leads to a premature filling of the digestive tract that leads to diarrhea.

In the spring, when emerged bees are out of the cells, they are not viable, they have undeveloped wings and deformed legs and heads. Therefore, they fall on the bottom of the hive, being removed by the healthy bees (Mărghitaş, 2002).

This is another example of 'undertaker' job performed by the colony. Unfortunately, the parasite has adapted to the biology and lifestyle of the honeybee, all treatments so far, being rather ineffective.

Nosema ceranae is a microsporidian parasite originating from the Asian honeybee, *Apis cerana*. The parasite is cross infective with the European honeybee, *Apis mellifera*. It is not known when or where *N. ceranae* first infected European bees, but *N. ceranae* has probably been infecting European bees for at least two decades. *N. ceranae* appears to be replacing *Nosema apis,* at least in some populations of European honeybees. This replacement is an enigma because the spores of the new parasite are less durable than those of *N. apis*.

Virulence data at both the individual bee and at the colony level are conflicting possibly because the impact of this parasite differs in different environments. The emergence of the disease is known being related to the mass contamination during spring comb cleaning (Mărghitaş, 2002). One of the most interesting behaviors in this case is that the infected bees crawl in front of the hive entrance where they die, because they seem to have the 'will' to leave room for healthy bees to perform their activities.

CONCLUSIONS

Until now, several papers have been written regarding social behavior in social insects at the individual level. It is quite difficult, though, to have a proper study at the colony level, therefore, a correlation between the two types of studies must be done. Experiments may be very useful being done at individual level, concerning the behavior of honeybees when they are artificially infected versus healthy bees. This might prove that the honeybees have the genetic mechanism to fight themselves against most of the diseases.

REFERENCES

1. Cremer, S., Armitage A.O., Schmidt-Hempel P. (2007) Social Immunity, Current Biology 17, R693-R702.
2. Cremer, S., Sixt M. (2008), Analogies in the evolution of individual and social immunity, Philosohical Transactions of the Royal Society.
3. Drum, N.H., and Rothenbuhler, W.C. (1985). Differences in nonstinging aggressive responses of worker honeybees to diseased and healthy bees in May and July. J. Apicult. Res. 24, 184–187.
4. Mărghitaş, L.Al. (2002). Albinele şi Produsele lor, Editura Ceres.
5. Pie, M.R., Rosengaus R.B., and Traniello J.F.A. (2004). Nest architecture, activity pattern, worker density and the dynamics of disease transmission in social insects. J. Theor. Biol. 226, 45–51.
6. Rothenbuhler, W.C. (1964). Behavior genetics of nest cleaning in honey bees. IV. Responses of F1 and backcross generations to disease-killed brood. Am. Zool. 4: 111-123.
7. Schmid-Hempel, P. (1998). Parasites in Social Insects (Princeton, New Jersey: Princeton University Press).
8. Waddington, K.D. and Rothenbuhler W.C. (1976). Behaviour associated with hairless-black syndrome of adult honeybees. J. Apicult. Res. 15, 35–41.
9. Wang, D.I. and Moeller F.E. (1970). The division of labor and queen attendance behavior of Nosema-infected worker honey bees. J. Econ. Entomol. 63, 1539–1541.