CHAPTER 8

CONCLUSIONS AND RECOMMENDATIONS

Results presented in this study show that new colonies of *A. dorsata* may start in a mite–free condition or with small infestations of *T. clareae* because no mites were found in the 6 new colonies of *A. dorsata*. This is probably due to efficient grooming behavior of *A. dorsata* to remove mites from their bodies and broodlessness during the swarming events that interrupt the mite's life cycle. *T. clareae* reinfests to new *A. dorsata* nests and the mite populations gradually build up in the established colonies of *A. dorsata* since the sixteen established colonies of *A. dorsata* had 0-146 *T. clareae* in the sampled capped brood, and 0-647 mites in sealed brood of the 13 deserted combs of *A. dorsata*. However, *T. clareae* populations can not grow in *A. dorsata* colonies to a dangerous level because this bee species has developed a high level of genetic resistance to suppress the reproduction of *T. clareae*. The results here showed that 65.2% of *T. clareae* did not reproduce in worker brood cells of *A. dorsata*. Also, *A. dorsata* has efficient grooming behavior which removes mites and kills them which is indicated by a large number of injured *T. clareae* (93.8%) in the debris from *A. dorsata* colonies. Thus, these defensive mechanisms of *A. dorsata* produced the low infestation rates of *T. clareae* in sealed brood cells of the established (1.8%) and deserted (13.5%) colonies and on the adult bees (0.3%).

In the present study, *T. clareae* was not a main cause of migrations of *A. dorsata* colonies because low infestation rates in brood cells (0-30%) and small numbers of *T. clareae* (0-63 mites) were left in the 12 deserted combs of *A. dorsata*. Three *A. dorsata* colonies migrated after several swarms left the colony and insufficient bees remained to manage the colony. However, one *A. dorsata* colony in this study might have migrated because of *Tropilaelaps* since a high infestation rate in brood cells (74.3%) and a large number of mites (647) were observed in a deserted comb of *A. dorsata*.

The average number of progeny produced by the reproductive mites of *T. clareae* in worker brood cells of *A. dorsata* (1.7±0.4), domestic (1.8±0.3) and ARS Primorsky (2.0±0.3) honey bees were not significantly different. On average, a reproductive *T. clareae* produced 1.8±0.4 progeny. About 42% of the reproductive mites produced 1, 37% produced 2, 16.2% produced 3, 3.2% produced 4 and 0.3-0.8% produced 5-8 progeny. The female biased sex ratio of *T. clareae* (male to female) from *A. dorsata* colonies was 1:4.5-1:5.5 in brood cells, 1:2.4 on the adult bees and 1:19.9 in the debris.

A. dorsata had higher genetic resistance and grooming efficiency to *T. clareae* than the ARS Primorsky and domestic honey bees. For genetic resistance, the percentage of non-reproductive mites in *A. dorsata* colonies (65.02±5.1%) was significantly higher than that of the Primorsky (48±5.2%) and domestic (50±3.8%) colonies. For grooming behavior, the percentage of injured mites from the debris of *A. dorsata* colonies (93.8%) was higher than that of the Primorsky (72.7%) and domestic (70.3%) colonies.

The ARS Primorsky and domestic honey bees had resistance to *T. clareae* in the same level because the two bee stocks did not show significant differences for the average infestation rate of *T. clareae* on the adult bees (0.5±0.1- 0.8±0.2%), non-reproduction of *T. clareae* (48±5.2-50±3.8%), mite numbers per colony (871.5±179.5-954.9±184.6), mite numbers per infested cell (2.4±0.2 - 2.9±0.2), colony longevity (4.6±0.5 - 6.2±0.8 months), removal rates of freeze-kill brood (82.6+5.8 – 85.5+5.4 %) and injured mite percentages in the debris (70.3-72.7%). For the hygienic behavior, 50% of the Primorsky colonies and 50% of the domestic colonies showed the hygienic trait.

Based on the success of *A. dorsata* in controlling mites and the inability of the Primorsky and domestic honey bees to do so, the most promising avenue is the transfer of the behavioral resistance adaptations of *A. dorsata* to *A. mellifera* or the use of selection for resistant stocks and breeding programs to increase the level of resistant genetics in *A. mellifera*. For the transfer of resistant genes from *A. dorsata* to *A. mellifera*,

this would be through the use of biotechnology since fertile hybrids between these two species can not be made. There are two major obstacles to such a transfer at present. The first obstacle is that the knowledge of the genetic basis in *A. dorsata* for this mite resistance is not yet know. Obtaining such knowledge will take a large amount of work over several years. The second obstacle is that the technology to make such transfers in honey bees is not yet available. Similarly, this will require much work and time. For selections, *A. mellifera* that has coexisted with *T. clareae* for the longest time should be tested for resistance to the mite because *A. mellifera* may have genetic traites which impart resistance to *T. clareae* which have already been selected for to some degree in such populations. After that, breeding programs should be used to produce resistant hybrids or to increase the level of resistant genetics in *A. mellifera* to *T. clareae*.