CHAPTER 1

General introduction and thesis objectives

Honey bees (family Apidae) are important commercial insects. They produce not only honey, but are premier pollinators of various crops, both commercial and wild. While pollinators include a wide range of insect taxa, bees are the most effective pollinators (Klein et al., 2007). It is estimated that 35% of global food production, fruits, vegetables and non-agricultural crops are dependent on honey bees (Genersch, 2010). Approximately 80% of the global agricultural pollination service is provided by the European honey bee (*Apis mellifera*) (Carreck and Williams, 1998). vanEngelsdorp et al. (2007) report that honey bees also produce other economically significant bee products such as propolis, pollen, royal jelly and beeswax. There is a concern that *A. mellifera* colony numbers are decreasing worldwide. The phenomenon of unexplained honey bee colony losses has been termed Colony Collapse Disorder (CCD). Several diseases, parasites and environmental threats are thought to influence the increasing colony losses (Xu et al., 2009; Genersch, 2010).

In Thailand there are close to 300,000 managed colonies of *A. mellifera*, most of which are located in the Northern provinces of Chiang Mai and Lamphun (Wongsiri et al., 2000; Sanpa and Chantawannakul, 2009). One of the most serious threats to *A. mellifera* beekeeping in Thailand is acarine brood mite parasitism. Nearly all beekeepers experience high infestations from mites on an annual basis. There are two mite species responsible: *Varroa destructor* (family Varroidae) and *Tropilaelaps mercedesae* (family Laelapidae). Studies on the population dynamics of *Varroa* and *Tropilaelaps* and their pathogenic effects on infested *A. mellifera* are very limited.

Parasitic honey bee mites are considered the most serious problem for *A. mellifera* beekeeping worldwide. In temperate regions, *V. destructor* is the serious parasite of *A. mellifera*, while *Tropilaelaps* is the more threatening of the two brood mite species in tropical regions. Both parasitic mites have similar pathogenic effects. Severe infestations by *Varroa* or *Tropilaelap*s mites ultimately bring about the death of honey bee colonies (Atwal and Goyal, 1971). Negative effects include morbidity and mortality of honey bee brood and adult bees that eventually surpasses natality and ultimately results in total colony collapse (De Jong et al., 1982). Although concurrent infestations of both *Varroa* and *Tropilaelaps* mites are normally observed in *A. mellifera* colonies in Southeast Asia, *Tropilaelaps* infestations at the individual colony levels are often higher than that of *Varroa* in Thailand (Burgett et al., 1983).

The honey bee, *A. cerana*, is another cavity nesting species, native to Southeast Asia which has a long history of human association in man-made hives similar to *A. mellifera*. *A. cerana* is commonly referred to as the eastern honey bee and is the natural host of *Varroa*. Peng et al. (1987a; 1987b) first reported the behavioral and physiological resistance mechanisms of *A. cerana* to *V. jacobsoni* (presumed to be *V. destructor*.) Recent molecular techniques show that the genus *Varroa* consists of at least four sibling species, two of which are competent as brood parasites of *A. mellifera*. The most frequently encountered and considered to be the most serious *Varroa* mite parasitizing *A. mellifera* was renamed *V. destructor* (Anderson and Trueman, 2000).

Viral diseases of honey bees are also direct or indirect contributors to honey bee colony losses (Chen and Evans, 2007; Chen et al., 2008). *Varroa* mites are known vectors of deformed wing virus (DWV) (Chen et al., 2008). Additional research has demonstrated that *Tropilaelaps* also serves as a vector for DWV (Dainat et al. 2009; Forsgren et al. 2009, Khongphinitbunjong et al. in press). DWV infection is characterized by wing deformation (Chen and Evans, 2007; Chen et al., 2008).

This dissertation describes findings on the prevalence and reproduction of *Varroa* and *Tropilaelaps* on adapted and non-adapted honey bee hosts. The impact of *Tropilaelaps* on infested hosts was also investigated. Moreover, the ability of two haplotypes of *Varroa* to reproduce in both *A. mellifera* and *A. cerana* was examined. To set the background for the research, Chapter 2 summarizes general knowledge regarding native honey bees and commercial honey bees in Northern Thailand and honey bee ectoparasitic mites interaction between two parasite species in an adapted host and alternative host.

In Chapter 3, I described the comb structure of *Apis dorsata* F. and compared *Tropilaelaps* infestations between worker and drone brood.

In Chapter 4, I monitored the seasonal abundance and interspecific competition between *Varroa* and *Tropilaelaps* mites when infesting the same *A. mellifera* host.

The reproductive success of cross-infested *Varroa* from *A. cerana* to *A. mellifera*, and *Varroa* from *A. mellifera* to *A. cerana* was discussed in Chapter 5.

In addition, I assessed the effects of *T. mercedesae* parasitism on the weight of different post capping stages of *A. mellifera* worker and drone in Chapter 6.

Finally, Chapter 7 summarizes and discusses results obtained from this dissertation.

Research objectives

1. To determine the relative effects of the interactions between the two mite species on their population dynamics when infesting the non-adapted domesticated honey bee (*A. mellifera*) as a host species.

2. To determine if mite abundance is associated with nectar flow or weather.

3. To establish combined impacts of both mite species on honey bee hosts.