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The Efficacy of Bayvarol® and CheckMite+® in the Control of *Tropilaelaps mercedesae* in the European Honey Bee (*Apis mellifera*) in Thailand

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Abstract

The effectiveness of flumethrin strips (Bayvarol®) and coumaphos strips (CheckMite+®) in the control of *Tropilaelaps mercedesae* in European honey bee (*Apis mellifera* L.) colonies in Thailand was tested between August 29, 2007 and October 4, 2007 in the apiary of the Bees and Bee Products Research Unit, Faculty of Agriculture, Chiang Mai University. The results demonstrated the high efficacy of Bayvarol® and CheckMite+® against *T. mercedesae* in the European honey bee. The decreasing percentage of *T. mercedesae* in each colony in the first, second, third and fourth week after treatment with Bayvarol® averaged 86.1, 51.6, 94.2 and 100 % elimination respectively. The decreasing percentage of *T. mercedesae* in each colony in the first, second, third and fourth week after treatment with CheckMite+® averaged 84.2, 87.6, 99.6 and 100 % elimination respectively.

Introduction

Varroa jacobsoni Oudemans (now *Varroa destructor*) was described in 1904, and *Tropilaelaps clareae* Delfinado and Baker (now *Tropilaelaps mercedesae* Anderson and Morgan 2007) was described in 1962. The re-classification of the genus Tropilaelaps is based on genetic and morphological variation of the parasite [1]. *V. destructor* was originally a parasite of *Apis cerana,* while *T. mercedesae* was originally a parasite of *Apis dorsata,* both tropical bee species. The mites *V. destructor* and *T. mercedesae* currently represent serious problems in Thai bee colonies due to their parasitic relationship with *Apis mellifera*. Mites have been reported as damaging brood and bees in honeybee colonies in tropical Asia for many years. Since 1961 several mites which

infest brood or adults of different species of honey bees have been identified and studied, and it now seems likely that much of the severe damage reported earlier in China, the Philippines and in other countries was due to mites, especially *V. destructor* and *T. mercedesae* [2]. *V. destructor* and *T. mercedesae* cause enormous damage to the beekeeping industry throughout Asia [3]. Since 1979, *T. mercedesae* has been reported as causing serious problems and damage to the honey bee population in Thailand.

Thai beekeepers have been forced to use unapproved products containing chlorobenzilate, phenothiazine, sulphur, amitraz or different pyrethroids to control the mite infestation as no approved miticides for use in bees has been available to date. Uncontrolled use of these agents has led to the development of resistance, resurgence of the infestation and the risk of residues in the honey which might pose a risk for human consumption. The tested miticides might be able to solve this problem in the Thai beekeeping industry, once they have been approved, if they are applied regularly and according to the recommendations. Introduction of these scientifically approved miticides would be beneficial to beekeepers and could boost the production and export of high quality honey.

The objective of this experiment was to study the efficacy of plastic strips impregnated with flumethrin 0.06 % (Bayvarol®, Bayer HealthCare AG, Germany) or coumaphos 10 % (CheckMite+®, Bayer HealthCare AG, Germany) against *T. mercedesae*. Their efficacy needs to be compared with the efficacy of tau-fluvalinate 10.3 % (Apistan®, Vita Europe Limited, United Kingdom) which has been reported to be efficacious against *T. mercedesae* in honey bees [4].

Materials and Methods

The trial site was the apiary of the Bees and Bee Products Research Unit, Faculty of Agriculture, Chiang Mai University, Thailand. The study lasted from August 29, 2007 to October 4, 2007. Twenty queen right colonies with about 14,000 bees and 1 mated queen and with a normal brood pattern (eggs, larvae and pupae) were used. At the start of the trial the colonies occupied 8-10 frames: the 4 middle frames contained brood while the other frames contained the pollen and honey stores. Bee colonies were naturally infested with *T. mercedesae*. Bee colonies were randomly allocated to 4 treatment groups of 5 colonies each. Groups were treated with CheckMite+® strips, Bayvarol® strips and Apistan® strips respectively. Two strips were placed between frames close to the brood nest area for 6 weeks. The fourth group remained untreated. The hives were arranged in groups. Within each group the hives were standing side by side. Between the groups there was a minimum distance of 10 metres. At the start of the study all the colonies were naturally infested with *T. mercedesae*. During the study period each colony was fed 0.5 litres of sugar syrup every week. The feeding is part of common beekeeping practice in this season. The location did not guarantee relevant amounts of nectar during the treatment period, whereas some pollen was still available.

To assess the efficacy, the mite population in the brood of all bee colonies was examined from week 0 to week 6 at weekly intervals. *T. mercedesae* infestation was checked by randomly sampling 100 pupae cells from 3 brood frames. Cells were inspected individually for infestation with mites and mite numbers were recorded. To compare the mite infestation between the groups geometric means were calculated to To calculate the efficacy, the mean of mites per colony in the treatment groups (N_t) was compared with the mean of mites per colony in the control group (N_c) at each time point. To follow a normal distribution more closely and not to overbalance extreme values geometric means were calculated as recommended by guidelines on assessment of parasitic drugs [5]:

$$\text{Efficacy (\%)} = \frac{N_c - N_t}{N_c} \times 100$$

Results and Discussion

At the start of the study (week 0), the number of mites (geometric mean of 5 colonies in each case) counted in 100 pupae cells was 30.8 to 35.4 in the 4 study groups. The number of mites in the control group was still at a high level at the end of the study in week 6. In contrast, the number of mites decreased in all treatment groups. By week 4, no mites were found in colonies treated with Bayvarol® or CheckMite®+; no mites were found in colonies treated with Apistan® by week 6 (see Figure 1).

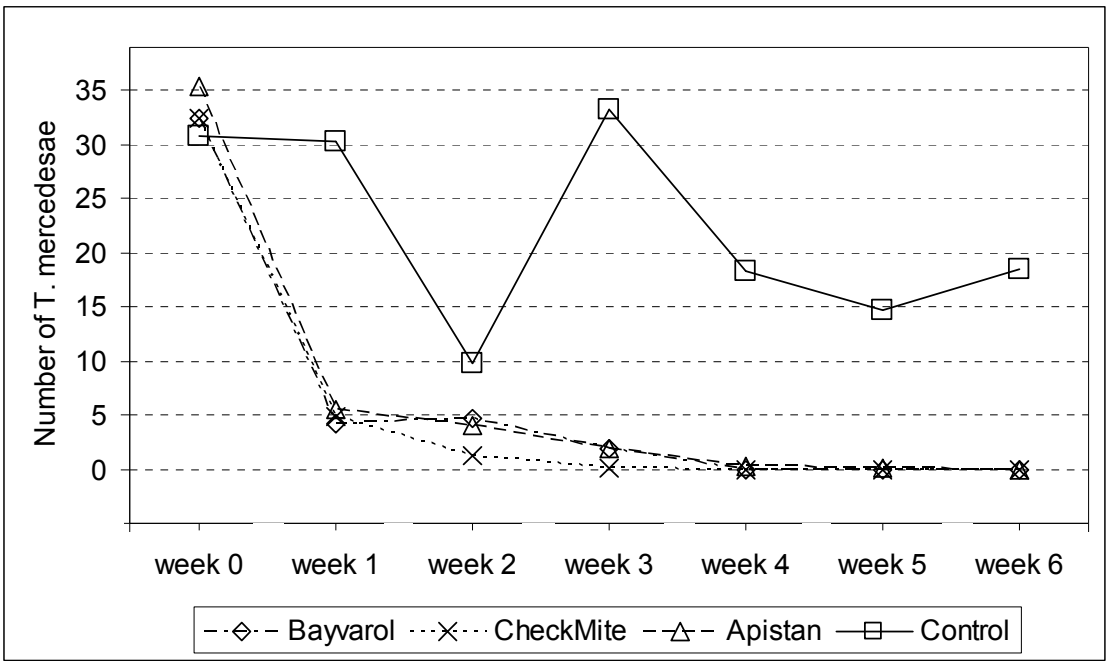

Fig.1: Number of *T. mercedesae* in 100 pupae cells (geometric mean of 5 colonies in each case)

The efficacy calculated by comparing the number of mites (geometric mean of 5 colonies in each case) at all time points is shown in Table 1. The multivariate test (Wei-Lachin procedure, alpha = 0.01, one-sided) over all time points showed descriptive superiority for all treatments over the control group (CheckMite+® and Bayvarol® group $p < 0.0001$, Apistan® group $p = 0.001$).

	week 1	week 2	week 3	week 4	week 5	week 6
CheckMite+®	84.2 %	87.6 %	99.6 %	100 %	100 %	100 %
Bayvarol®	86.1 %	51.6 %	94.2 %	100 %	100 %	100 %
Apistan®	81.6 %	59.3 %	94.1 %	98.3 %	99.0 %	100 %

Tab.1: Efficacy of treatment against *T. mercedesae* (based on geometric means per group, compared to the geometric mean in an untreated control group)

In this study, the highest efficacy against *T. mercedesae* was demonstrated for the treatment with CheckMite+®, especially in the first three weeks. A multivariate test (Wei-Lachin procedure, alpha = 0.010, one-sided) over all time points showed descriptive superiority of the CheckMite+® group vs. the Apistan® group ($p = 0.0757$). It was not possible to show superiority of the Bayvarol® group vs. the Apistan® group. However, it has to be considered that small colonies with only 14,000 bees and with a normal brood pattern were used in this study. Thus just 2 strips of Bayvarol® were used per colony. In larger colonies, according to the label recommendations, 4 Bayvarol strips have to be used whereas even in larger colonies the number of CheckMite+® strips or Apistan® strips per colony is only 2. Thus under practical conditions with a larger colony size the efficacy of Bayvarol® might be even higher compared to treatment with CheckMite+® or Apistan®.

Whereas the efficacy of Apistan® against *T. mercedesae* has been reported previously [4], this is the fist report on the efficacy of Bayvarol® and CheckMite+® against this bee parasite. There are proven records of the efficacy of both products against *Varroa destructor* [6, 7]. Together with the data from our study, it is evident that Bayvarol® and CheckMite+® can be successfully used for treatment of both *V. destructor* and *T. mercedesae*.

Many beekeepers use products not according to label instruction or unapproved products to control mite infestations in bee colonies. Such misuse may cause the development of resistance, resurgence of the infestation and the risk of residues in the honey which might pose a risk for human consumption. The tested miticides provide beekeepers a legal solution to fight both *Tropilaelaps* and *Varroa* mites in bee colonies. Thus, treatment with these products could help to boost the production of high quality honey.

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