# Chapter 21

# Integrated Control Methods of Parasitic Mites on Honeybees

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Among 11 species of honeybee mites known in Korea (Woo and Lee, 1993), economic losses caused by *Varroa jacobsoni* and *Tropilaelaps clareae* have been enormous since their introduction. Even though Woyke (1987) and Cobey and Lawrence (1988) discussed control methods of *V. jacobsoni* and *T. clareae* other than acaricides, a questionnaire survey in 1993 by Woo *et al.* (1994) revealed that Korean beekeepers regard spraying acaricides as the only method of control (Table 1).

The problem is heavy dependence on acaricides resulting in residues in honey and mite-resistance as well as an increase in costs for beekeepers. This paper reports experiments performed to find the optimum number of treatments of acaricides and other methods to control bee mites, and discusses effective methods that can be used in an integrated way to control *V. jacobsoni* and *T. clareae* based on recent research (Woo, in press).

**Table 1.** Results of questionnaire survey on the number of acaricide treatments a year

| Number of treatments (times) | Number of respondents | Ratios (%) |
|---|---|---|
| 2 | 5 | 1 |
| 3–4 | 22 | 6 |
| 5–6 | 41 | 11 |
| 7–8 | 45 | 12 |
| 9–10 | 54 | 15 |
| 11–12 | 30 | 8 |
| 13–14 | 35 | 9 |
| more than 15 | 140 | 38 |
| Total | 372 | 100 |

**Table 2.** Chemical control of bee mites

| Acaricides | Major chemical component(s) |
|---|---|
| Micut, Mitac, Baam | Amitraz 20% |
| Apistan | Fluvalinate 10% |
| Apitol | Cymiazol (350 mg/2 g) |
| Bayvarol | Flumetrin |
| Folbex-VA | Bromopropylate (370 mg/ 1 strip) |
| Dacar | Unknown |
| Mavrik | Fluvalinate 5% |
| Formic acid | Formic acid |
| Perizin | Coumaphos 8g/1*l* |
| P2 | Unknown |
| Apilife Var | Thymol, Eucalyptol, Menthol, and Camphor |

## Chemical Control of *Varroa jacobsoni* and *Tropilaelaps clareae*

As shown in Tables 1 and 2, on average eleven treatments of various acaricides are given to control bee mites.

Recent research (Woo, in press) reports that Apistan and Bayvarol give relatively and slightly better results than others for controlling *V. jacobsoni* (Tables 3 and 4), but all acaricides guarantee good results.

**Table 3.** Control effects of various acaricides on *Varroa jocobsoni*

| Acaricide | No. of honeybee mites controlled (in total) | No. of honeybee mites survived | Infestation (%) | Control effect (%) |
|---|---|---|---|---|
| | 97 | 389 | 4.86 | 19.96 |
| Control | 396 | 1197 | 9.96 | 24.86 |
| | 137 | 338 | 3.39 | 28.84 |
| | 984 | 36 | 7.29 | 96.47 |
| Apistan | 597 | 1 | 4.27 | 99.83 |
| | 163 | 3 | 1.38 | 98.19 |
| | 754 | 37 | 5.65 | 95.32 |
| Bayvarol | 980 | 155 | 7.09 | 86.34 |
| | 569 | 121 | 5.75 | 82.46 |
| | 94 | 57 | 1.51 | 62.25 |
| Folvex-VA | 169 | 56 | 2.25 | 75.11 |
| | 357 | 83 | 3.67 | 81.14 |

**Table 4.** Control effects of various acaricides on *Tropilaelaps clareae*

| Acaricide | No. of honeybee mites controlled (in total) | No. of honeybee mites survived | Control effect (%) |
|---|---|---|---|
| | 1,600 | 5,102 | 23.87 |
| Control | 1,813 | 6,566 | 21.63 |
| | 2,165 | 8,891 | 19.58 |
| | 4,599 | 312 | 93.59 |
| Apistan | 7,472 | 678 | 91.68 |
| | 7,537 | 783 | 90.58 |
| | 4,903 | 625 | 88.69 |
| Bayvarol | 3,102 | 436 | 87.67 |
| | 4,574 | 631 | 87.87 |
| | 7,436 | 688 | 91.53 |
| Micut | 4,037 | 596 | 87.11 |
| (X 1,000) | 6,108 | 824 | 88.11 |
| | 4,145 | 2,132 | 66.03 |
| Perizin | 2,698 | 1,001 | 72.93 |
| | 3,241 | 1,233 | 72.44 |

Investigation of seasonal infestation rates (Table 5) reveals that at most three treatments are required for control of *V. jacobsoni* and *T. clareae*.

Inspection of colonies should be made before chemical treatment. Acaricides can be applied before overwintering (September–October) and after overwintering (March–April). However, application can be made in June only just before population density reaches a peak, and avoided if density is low before and after overwintering. Also, Tables 3 and 4 indicate that most acaricides are effective for control. Thus, more than two acaricides should be used together and in turn, rather than sticking to one as this helps to slow down the development of resistance by mites to acaricides.

## Survival of *Tropilaelaps clareae* during Winter

Infestation rates of *T. clareae* during overwintering is 19.2% although it varied in different areas. Investigation in the Cheju Islands (Woo, in press) shows that *T. clareae* can survive during winter when average temperatures are higher than 2°C (Table 6; Fig. 1). This observation indicates that if bee colonies are kept in places where temperature are below 2°C, spread of *T. clareae* can be effectively prevented.

Contrary to Woyke (1997), recent research (Woo, in press) also reveals that adult *T. clareae* can survive for 5–7 days without existence of a host.

## Colony Management

In migratory beekeeping, *V. underwoodi* changes host from *A. cerana* to *A. mellifera*. Where migratory beekeeping is common, this fact should be noted to prevent wider spread of *V. underwoodi*. Also the maintenance of strong colonies is key to preventing the spread of bee mites and damage by them.

**Table 5.** Seasonal infestation rates of *V. jacobsoni*

| | Seasonal Infestation Rates | | | | | |
|---|---|---|---|---|---|---|
| | April 1997 | | June 1997 | | October 1997 | |
| | No/Comb | Rate(%) | No/Comb | Rate(%) | No/Comb | Rate(%) |
| Worker (uncapped) | 3/50 | 6 | 36/100 | 36 | 247/680 | 36 |
| Drone (uncapped) | 25/100 | 25 | 63/90 | 70 | - | - |

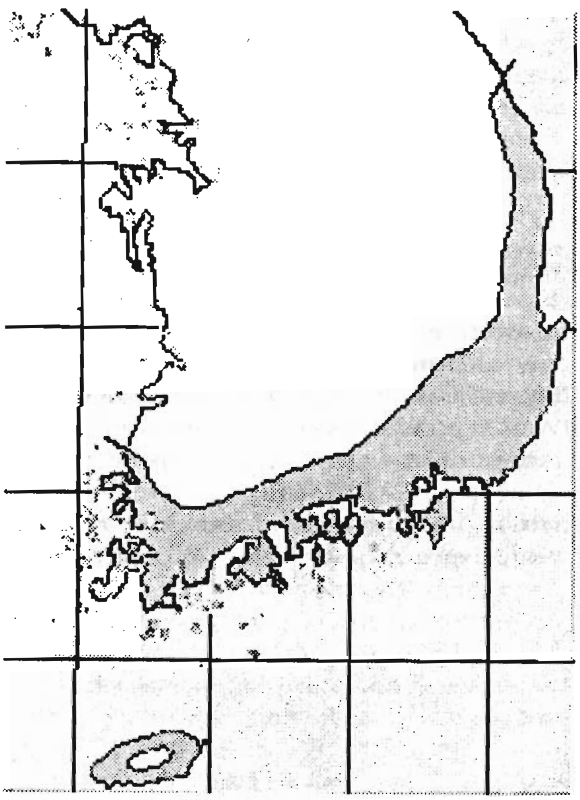

**Fig. 1.** Areas of Korea where *T. clareae* can survive during winter (Woo, in press).

**Table 6.** Infestation rates of *T. clareae* in overwintering bee colonies at different altitude

| Locality | Altitude (m) | Brood area |
|---|---|---|
| Cheju city | 100 | Present |
| Bukcheju-Kun | 100 | Present |
| Seoguipo City | 100 | Present |
| Namcheju-Kun | 200 | Present |
| Bukcheju-Kun | 400* | Absent |
| Sansemibong | 600* | Absent |

*The average temperature of marked areas are below 2°C. Temperatures of other areas fall in the range between 4–7°C in December, January and February.

**Table 7.** Development period of each stage of *T. clareae* in Korea

| | Developmental period of each stage (hours) | | | | |
|---|---|---|---|---|---|
| | Egg | larva | pre-nymph | deuto-nymph | Total |
| Worker | 7.2 - 9.6 | 7.2 - 14.4 | 38.8 - 42 | 72 - 86.8 | 144 |

## References

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