

Scientific note

A scientific note on *Apis mellifera* brood attractiveness to *Varroa destructor* as affected by the chemotherapeutic history of the brood

James D. ELLIS J.*, Keith S. DELAPLANE**

Department of Entomology, University of Georgia, Athens, GA 30602, USA

(Received 21 September 2000; revised 11 May 2001; accepted 18 May 2001)

***Varroa destructor* / brood attractiveness / antibiotics / Fumidil B / Terramycin**

There is evidence for a positive correlation between the level of *Varroa destructor* Anderson and Trueman infestation in a colony and the attractiveness of the brood to the mites (Büchler, 1989, 1990). This correlation may be associated with actual increases in colony mite levels as suggested by the work of Fuchs (1992) who was able to confirm a significant correlation between brood attractiveness and colony mite increase and a positive correlation between brood attractiveness and fertility of the mites. Differences in brood attraction may be associated with race differences in bees (Büchler, 1989). The present study was designed to test if brood attraction also can be affected by the chemotherapeutic history of the brood. The agents tested in this experiment were Fumidil B® (fumagillin) and Terramycin® (oxytetracycline), two antibiotics widely used in apiculture.

The methods are described schematically in Figure 1. Four genetically distinct lines of honey bees were identified (one queen per line). Two of the four lines were headed by free-mated queens (each

from a different queen producer) while the other two were single-drone instrumentally inseminated queens. Each line was housed in a single story Langstroth colony. Each genetic line colony was treated with 2 strips of Apistan acaricide (fluvinate) for 2–4 weeks prior to the start of the experiment and fed sugar syrup until colonies had similar reserves of food.

Four different (medicated) colonies were set up to receive test antibiotics. Each medicated colony was requeened with one of four free-mated, sister queens. These colonies were isolated from other colonies to minimize *V. destructor* drift and treated with Apistan for 24 days immediately prior to receiving the antibiotics. Fumidil B was delivered in 1:1 sugar syrup and Terramycin was delivered in powdered sugar, both at mixture rates recommended by manufacturers. Each of the medicated colonies received one of the following treatment regimens: (1) Fumidil B-treated sugar syrup and a dry mixture of Terramycin and powdered sugar applied to the tops of frames, (2) Fumidil B and non-medicated

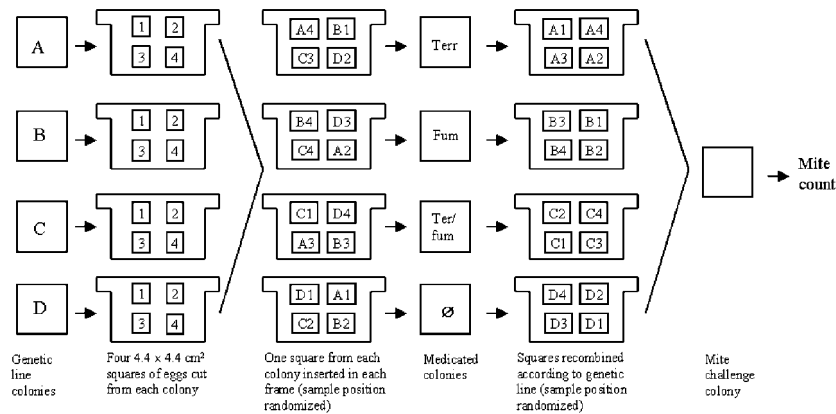


Figure 1. Schematic of methods used to appraise *V. destructor* attraction to bee brood from four genetic lines and four chemotherapeutic regimens (one trial represented).

* Current address: Department of Zoology and Entomology, Rhodes University, Grahamstown, South Africa 6140.

** Correspondence and reprints. E-mail: ksd@uga.edu

powdered sugar, (3) Terramycin and non-medicated sugar syrup, and (4) non-medicated sugar syrup and non-medicated powdered sugar (control). The medicated colonies received their chemical regimens beginning 33 days prior to the start of the experiment and throughout the duration of the experiment.

Two additional (mite challenge) colonies were identified for use during the experiment. These colonies were heavily infested with *V. destructor* but apparently free of other disorders. They were never treated with antibiotics or acaricides.

Each queen from the four genetic line colonies was placed on a drawn, broodless comb contained in a queen excluder cage at time (t) = -12 h. Twenty four hours later (t = 12 h) the queen was removed from the frame, the midpoint of the two times being t = 0. Each frame with eggs was left in its respective genetic line colony for 24–28 h, after which time four 4.4 × 4.4 cm squares of comb containing eggs were cut out of the frame using a metal spatula. One section of eggs was taken from each of the four genetic line colonies and the sections combined onto one modified frame. This was repeated for each of the three remaining sections of eggs taken from each genetic line colony. Each modified frame, holding eggs from each genetic line colony, was introduced into one of the four medicated colonies between t = 24–28 h. Mites invade worker cells from 15–20 hours preceding cell capping (t ~ 192 h) (Boot et al., 1992). Therefore, the squares of larvae were taken out of the medicated colonies from between t = 17–172.5 h and recombined onto single frames according to the genetic line colony from which they came. The frames were then placed into one of the mite challenge colonies (in each trial, all four frames were put into the same mite challenge colony) until the post-capping interval between t = 220–244 h. After this time, the squares of capped prepupae were taken out of the mite challenge colonies and chilled in a freezer to slow the mites and facilitate counting. All capped, live prepupae (n = 0–172) from each square were taken out of their cells and inspected for mites. Capped, live prepupae and adult female mites were counted in order to determine the ratio of mites per prepupa. This procedure was repeated with all four genetic line colonies for a total of 8 trials.

Table I. Effects of the chemotherapeutic history of brood on its attraction to *V. destructor*. The variable is the average number of adult female mites retrieved per live prepupa. Values are mean ± standard error. Number in parentheses is sample size (squares of brood). There were no significant differences among means.

	Fumidil B		row means
	present	absent	
Terramycin			
present	1.8 ± 0.3 (22)	1.6 ± 0.2 (23)	1.7 ± 0.2 (45)
absent	1.7 ± 0.3 (29)	1.4 ± 0.3 (26)	1.6 ± 0.2 (55)
column means	1.8 ± 0.2 (51)	1.5 ± 0.2 (49)	

The experiment was analyzed as a split-plot design recognizing as a whole plot each trial of four genetic lines and subplots as the four chemical regimens. Analysis of variance was conducted using the GLM Procedure in SAS (SAS Institute, 1990). The dependent variable was the average number of adult female mites retrieved per live prepupa in the sampled brood square (transformed as square root of (parameter + 0.5)), and it was tested against residual error. The effects of trial and genetic line were tested against their interaction term. For the sake of clarity, Table I presents non-transformed means.

The number of mites retrieved per prepupa did not differ among the main effects Fumidil B and Terramycin ($F \leq 1.9$; $df = 1.57$; $P \geq 0.2$; Tab. I). Neither did the main effects interact ($F = 0.2$; $df = 1.57$; $P = 0.7$). There were no differences among genetic lines ($F = 0.3$; $df = 3.20$; $P = 0.8$), but there was a trial effect ($F = 3.4$; $df = 7.20$; $P = 0.01$). The coefficient of variation for our model was 20.2%.

Our results suggest that the degree of *V. destructor* attraction toward honey bee brood is relatively unaffected by the chemotherapeutic history of the brood and by variation in brood genetic homogeneity within a range found with non-selected queens either open-mated or single drone-inseminated. If the attraction of brood is useful as a selection criterion for breeding programs, our data suggest that the chemotherapeutic history of brood is a negligible source of environmental variation, but that some time (trial) effects may be expected.

Note scientifique sur l'attractivité du couvain d'*Apis mellifera* sur l'acarien *Varroa destructor* en fonction du passé chimiothérapeutique du couvain.

Eine wissenschaftliche Notiz zum Effekt der chemotherapeutischen Vergangenheit auf die Attraktivität der Brut von *Apis mellifera* für die Milbe *Varroa destructor*.

REFERENCES

- Boot W.J., Calis J.N.M., Beetsma J. (1992) Differential periods of *Varroa* mite invasion into worker and drone cells of honey bees, Exp. Appl. Acarol. 16, 295–301.
- Büchler R. (1989) Attractivity and reproductive suitability for the *Varroa*-mite of bee brood from different origin, Proc. meeting of the EC-experts group, Udine, Italy, pp. 139–145.
- Büchler R. (1990) Possibilities for selecting increased *Varroa* tolerance in central European honey bees of different origins, Apidologie 21, 365–367.
- Fuchs S. (1992) Ein Testverfahren zum Vergleich der Varrooseanfälligkeit in kleinen Volkseinheiten, Ann. Univ. Mariae Curie-Sklodowska 47, 127–132.
- SAS Institute (1990) SAS/STAT User's guide, version 6, 4th ed., Volume 2, SAS Institute, Cary North Carolina, USA.