Multi-State Field Trials of ARS Russian Honey Bees

3. Responses to *Acarapis woodi* 1999, 2000

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Summary

ARS Primorsky honey bees were evaluated for their resistance to *Acarapis woodi* by monitoring natural infestations in colonies located in Iowa, Louisiana and Mississippi. In 1999, Primorsky colonies had lower levels of *A. woodi* infestation than the domestic colonies. Low tracheal mite infestations were also observed in 2000. The 10 Primorsky queen-lines tested were all resistant to tracheal mites. However, resistance was more pronounced in Louisiana and Mississippi wherein 0-3% infestations were recorded. It is possible that environmental factors influenced the degree of infestation between the states and within Primorsky lines, especially in Iowa. With careful selection, it is possible to further enhance resistance of Primorsky honey bees to tracheal mite parasitism.

INTRODUCTION

For 17 years, beekeepers in the United States have constantly battled to protect their colonies from *Acarapis woodi* parasitism. Despite the availability of chemical treatments such as menthol, this parasitic mite continues to kill honey bee colonies. With the presence of *Varroa destructor* in the colonies, increased colony mortality is likely to occur as colonies are weakened by both parasitic mites.

Recent studies showed that tracheal mite resistance is not present in all commercially available stocks (Danka and Villa 2000, Guzman et al. 2001a and b, In Press). While some commercial stocks have useful resistance to tracheal mites, others have high susceptibility to the parasite. The widespread use of resistant stock is essential to minimize colony losses for beekeepers.

The ARS Primorsky honey bees have been documented to have a strong degree of resistance to tracheal mites in Louisiana (Guzman et al. 2001a and b, In Press). In order to further assess their resistance capability, we monitored natural infestations of tracheal mites in colonies located in different states used for *V. destructor* research.

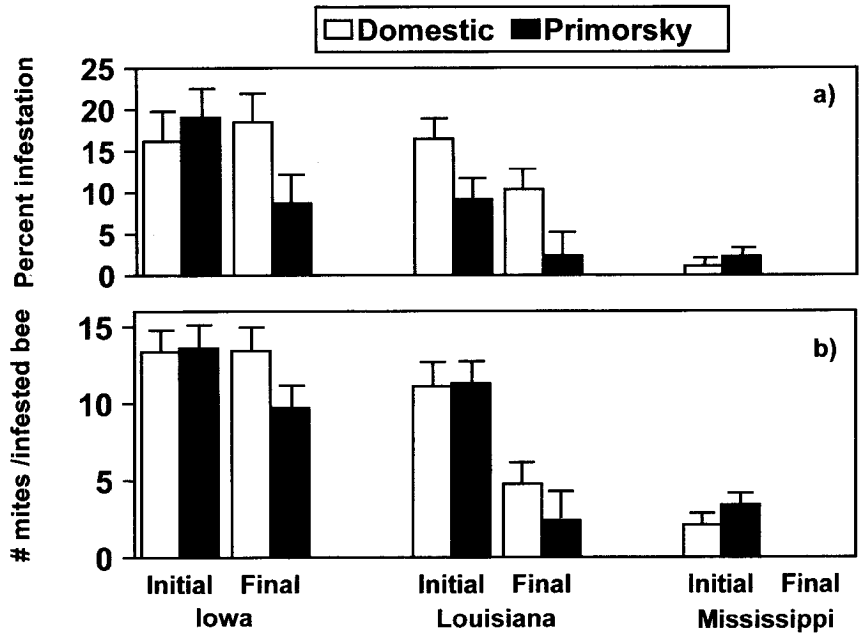
MATERIALS AND METHODS

Test colonies were established as described earlier by Rinderer et al. (2001 submitted, part one of this series). In brief, trials were conducted in 1999 and 2000 testing daughters of six and 10 queen lines of the Primorsky honey bees, respectively. The trials were conducted in Iowa, Louisiana, and Mississippi.

In 1999, the Primorsky honey bees were compared to commercial stock that has been traditionally used in each location. Forty-two Primorsky colonies and 42 domestic colonies were studied in each state, with the colonies divided equally among the apiaries. In 2000, only Primorsky queens (10 lines) were evaluated. Colonies were established in three apiaries per state. A total of 360 colonies were tested. Colonies in Iowa and Louisiana were on individual bottom boards, while colonies in Mississippi were on pallets.

In 1999, five-frame nucleus colonies for all locations were obtained by dividing domestic colonies. For 2000, infested (superseded colonies from the Iowa 1999 trial) and uninfested (from the Mississippi 1999 trial) colonies were brought to Louisiana in September 1999. The Iowa colonies were then re-queened with open-mated Primorsky queens of unknown lines. The two groups of colonies were located in different apiaries. The colonies that originated from Iowa were used to produce Iowa nucleus colonies for 2000 and those that came from Mississippi were divided to produce 2000 Mississippi

Figure 1. Prevalence (a) and intensity (b) of *A. woodi* in ARS Primorsky and domestic honey bee colonies in Iowa, Louisiana and Mississippi in 1999.



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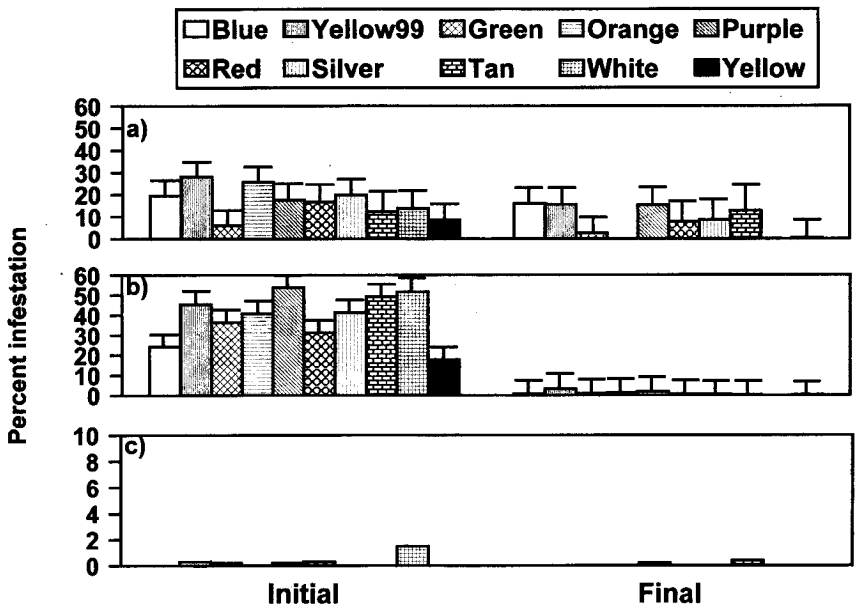

Figure 2. Prevalence of *A. woodi* in 10 lines of ARS Primorsky honey bees in Iowa (a), Louisiana (b), and Mississippi (c) in 2000. Colors were designated for each Primorsky line.

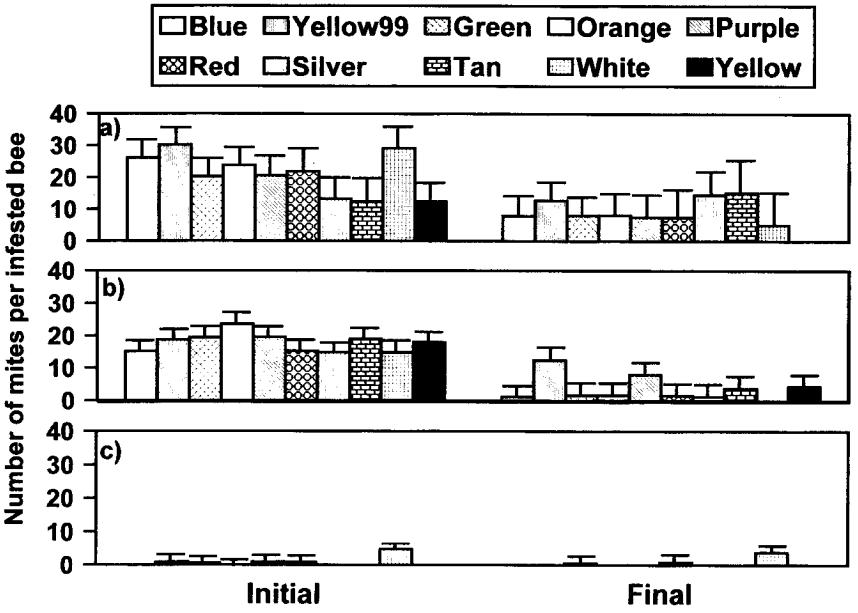

Figure 3. Intensity of *A. woodi* in 10 lines of ARS Primorsky honey bees in Iowa (a), Louisiana (b), and Mississippi (c) in 2000. Colors were designated for each Primorsky line.

nuclei. An additional 10 nucleus colonies were also produced for Iowa and were established with domestic queens. These colonies were located in a location different from that of the Primorsky test colonies during the experiment. Domestic colonies were used for producing nucleus colonies in Louisiana. All colonies were given the same management in each state.

A. woodi infestations were determined by dissecting 30 bees per colony at the beginning (April 1999 and May 2000) and at the end (August 1999 and September 2000) of the experiment. Initial infestations of the domestic colonies for the Iowa 2000 trial were not determined. Examination of bees was done using thoracic dissection (Lorenzen and Gary 1986).

Data on mean prevalence (proportion of bees infested) and mite intensity (number of mites per infested bee) were analyzed using ANOVA in a Split-plot design. Separate analyses were conducted for each state per trial using Proc Mixed. The main unit for each site in each state was the honey bee type, which had a Completely Randomized Design. The colony was considered as replication and sampling date was the subunit. Sampling date was a repeated measure, but since there were only two sampling periods, it was analyzed as a simple subunit effect. The honey bee type and sampling date were modeled as fixed effects. Site and all interactions involving site were considered as random effects. Degrees of freedom were estimated using the Kenward-Roger method. Before analyses, data for the prevalence were arcsine transformed and mite intensity was transformed using square root transformation (SAS Institute 1997).

RESULTS AND DISCUSSION

1999 Results. Trends of tracheal mite infestation were similar in all states. ARS Primorsky honey bees had lower tracheal mite infestations than the domestic colonies (Figure 1a). In Iowa, the Primorsky colonies had lower infestations of tracheal mites at the end of the experiment (P=001). In Louisiana, the overall infestation of the Primorsky colonies was lower (5.8±2.5%) than the domestic colonies (13.4±2.5%) (P=0.002). In Mississippi, infestations of tracheal mite were initially low and failed to develop by the end of the experiment.

The number of mites in individual infested bees was similar for both stocks in each state (Figure 1b). The initial and final numbers of tracheal mites in infested bees in Iowa were similar (11-13 mites) (P=0.307). However, the intensity of tracheal mites in both stocks decreased significantly (P=0.0001) from 11 to 4 mites at the end of the experiment in Louisiana. Infested bees in Mississippi had very few mites at the start of the experiment and mites were undetectable at the end of the experiment. These differences in the prevalence and intensity of tracheal mites between the three states suggest an environmental involvement that favored or deterred growth of mite populations in the colonies.

2000 Results. For the 2000 queen line evaluation, all Primorsky lines were similar (P=0.188) after 96 days of observation in Iowa (Figure 2a). The 10 queen lines had infestations that ranged from 0-16% at the end of the experiment. While the highest infestation observed in the Primorsky bees was 16%, the 10 domestic colonies located in a different site had a higher mean infestation of 41±9% (data not shown). *A. woodi* infestations from 20-25% have been reported to cause economic damage in bee colonies (Eischen 1987, Otis and Scott-Dupree 1992). Therefore, the infestations observed in all the Primorsky lines were below this economic threshold level.

In Louisiana, nearly all colonies started with damaging levels of tracheal mites that ranged from 18 to 54% (Figure 2b). Louisiana colonies started as domestic bees. After 91 days, when all colonies had

Primorsky bee populations, tracheal mite infestations in all colonies dramatically (P=0.0002) decreased to very low levels with infestations ranging from 0-3%, which was also observed in 1999. In Mississippi, where colonies started as Primorsky bees, very low to undetectable levels were observed both at the start and after 111 days of observation (Figure 2c). This drastic change in tracheal mite infestations was not clearly observed in Iowa where six lines had 0-8% and four lines had 13-16% at the end of the experiment. Again, it may be that environmental differences between the three states caused the disparity in tracheal mite infestations.

The number of mites per infested bee decreased at the end of the 2000 trial. In Iowa, mite intensity decreased from 21.0±3.3 to 8.6±3.6 mites (Figure 3a). The Primorsky lines had mite intensities ranging from 0-15 mites. The highest intensity of 15 mites was still lower than the average intensity of the ten domestic colonies which had 19±2.3 mites (data not shown). Similar trends were observed in Louisiana. Colonies started with 18.0±2.0 mites per infested bee and then fell to 4.0±2.0 mites at the end of the experiment (P=0.013) (Figure 3b). In Mississippi, infested bees from all the Primorsky lines had similarly low numbers of mites (P=0.691) (Figure 3c). Generally, mite intensity was highest in Iowa, which suggests an involvement of environmental factors.

Overall, results from both trials provided strong evidence that the Primorsky bees are resistant to tracheal mites. The queen lines evaluated were all resistant to the parasite. This observation corroborates recent results of field tests conducted in Louisiana (Guzman et al. 2001a and b, In Press). However, the difference in the degree of resistance among the Primorsky lines suggests that variation in resistance still exists in the stock. Thus, further selective breeding should increase tracheal mite resistance of the Primorsky honey bee stock. Since states vary, with Iowa providing the most favorable environment for the development of tracheal mite populations, trials in Iowa should provide the best opportunity to discern differences.

ACKNOWLEDGMENT

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ERRATA—PART I

In Part I of this series, that appeared in the September, 2001 *American Bee Journal,* the captions for Figures 3 & 4 are transposed. The caption for Fig. 3, page 660, should appear with the graph referring to 1999 trials, while the caption for Fig. 4, page 661, should appear with the graph referring the 2000 trials for average mite population growth.