Survey of Miticide Use in Georgia Honey Bee Hives

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ABSTRACT
In 1990, an estimated 32,007 Georgia bee hives were treated with menthol to control tracheal mites, and 20,771 hives were treated with Apistan® to control Varroa mites. In 1990, Georgia beekeepers spent at least $128,343 on miticides. If Georgia beekeepers had to rely solely on non-chemical controls against mites, they predict state-wide losses of hives and hive products of at least $5,748,091. Survey respondents represented 51,608 bee hives which are 46.5% of the hives in Georgia at the end of 1990.

KEY WORDS Apis mellifera, Acarapis woodi, Varroa jacobsoni, menthol, Apistan®

INTRODUCTION
Tracheal mites and Varroa mites have prompted increased use of pesticides in U. S. beekeeping. Menthol in 50-gram packets is the only approved miticide in the U. S. for controlling tracheal mites, and Apistan®, a fluvalinate-impregnated plastic strip, is the only approved miticide for controlling Varroa. Neither miticide controls both mites. Some bees resist tracheal mites (Gary & Page, 1987; Milne et al., 1991), but there is almost (Morse et al., 1991) no evidence that North American populations of honey bees resist Varroa mites.

Certain pesticides have been available to beekeepers for years (Nowogrodzki, 1990). However, the arrival of menthol and Apistan® has historic implications. First, unlike other pesticides, these are used inside hives of living bees for prolonged periods. Secondly, mites are serious parasites that must be controlled, and there are no nationwide legal alternatives to menthol and Apistan®. For the first time, U. S. beekeepers depend on pesticides inside living bee hives to maintain profitable operations.

Because the role of pesticides in U. S. beekeeping is growing, I surveyed Georgia beekeepers to learn their miticide use habits, alternative controls they use, and their estimates of yield changes from alternative controls.

METHODS
I designed an anonymous mail questionnaire to determine: 1) the number of Georgia hives treated in 1990 with menthol or Apistan®, 2) frequency of treatments, 3) rates of treatment (amount of menthol per hive or number of Apistan® strips per hive body), 4) costs of treatment per hive, 5) methods of application, 6) times of application, 7) alternative non-chemical controls used, 8) estimated productivity changes from non-chemical controls, and 9) respondents' personal data, experiences in beekeeping, and opinions of problems facing the industry.

The survey mail list came from Georgia Department of Agriculture registration records and membership lists of the Georgia and Southeast Georgia Beekeepers Associations. 1,813 questionnaires were mailed on 8 February 1991, and 31 were given out at beekeeper meetings during the next two weeks, so altogether 1,844 questionnaires were distributed. Reminder post cards were mailed 27 February. Returning questionnaires were accepted up to 8 April; 226 questionnaires were disqualified because they were not deliverable or respondents were not Georgia residents.

Data were stored on permanent tape at The University of Georgia Computing and Networking Service facility. Data were machine-edited to purge answers that were disqualified based on earlier responses, search for keying errors, and check ranges of values for suspicious extremes. SAS (SAS Institute, 1988) was used to generate descriptive statistics and frequency tables. I calculated 95% confidence intervals (Scheaffer et al., 1986) around certain sample percentages. Because the number of sampled hives was very high and the confidence intervals were consistently narrow, I used survey percentages to estimate state-wide conditions for several variables (see Table 1, footnote 1).

RESULTS AND DISCUSSION
378 qualified questionnaires were returned for a response rate of only 23.4% (378/1,618 qualified questionnaires). However, the 378 respondents owned 51,608 bee hives which are 46.5% of the bee hives in Georgia at the end of 1990 (111,000 hives treated by respondents).

Table 1. Number of Georgia bee hives treated with menthol or Apistan® in 1990

<table>
<thead>
<tr>
<th></th>
<th>Menthol</th>
<th>Apistan®</th>
</tr>
</thead>
<tbody>
<tr>
<td>no. hives</td>
<td>% ± CI'</td>
<td>no. hives</td>
</tr>
<tr>
<td>in survey</td>
<td>15,217 ± 0.3</td>
<td>32,007</td>
</tr>
<tr>
<td>state-wide</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Survey percentages ± 95% CI, where ± 1,838 bee hives sampled from population of 111,000 hives (23.4% sample size sampled in study; 1,838 bee hives treated with menthol or Apistan® in 1990. Menthol + Apistan® was sampled in March 1992. In survey) + 1,838 bee hives sampled from population of 111,000 hives (1,838 bee hives sampled in survey) + 1,838 bee hives sampled from population of 111,000 hives (1,838 bee hives sampled in survey).
hives; USDA-NASS, 1991). This is a good sample size of the population of interest, that is, bee hives in which miticides are potentially used.

Objective 1. Number of hives treated with menthol or Apistan®. Table 1 gives the number of survey hives treated with menthol or Apistan®, percentage of survey hives that were treated, and estimated number of hives treated state-wide. In 1990, an estimated 32,007 hives were treated with menthol, and 20,771 hives were treated with Apistan®.

Objective 2. Frequency of menthol or Apistan® treatments. Survey hives that were treated with menthol received, on average, 1.5 ± 0.7 treatments per hive in 1990, and hives treated with Apistan® received 1.1 ± 0.5 treatments. Table 2 gives treatment frequencies, number of survey hives in each category, percentage of survey hives in each category, and estimated number of hives state-wide in each category. With menthol, most hives received two treatments, but with Apistan® most hives received one treatment.

Objective 3. Rates of treatment. Table 3 lists rates of treatment, number of survey hives in each category, percentage of survey hives in each category, and estimated number of hives state-wide in each category. With menthol, most hives received one 50-g packet per treatment application, but cough drops and vegetable oil were popular alternatives. With Apistan®, most hives received two strips per hive body.

Objective 4. Costs of treatment. In 1990, respondents spent, on average, $2.2 ± 1.4 per hive to treat with menthol and $2.5 ± 1.5 per hive to treat with Apistan®. Using data from Table 1, estimated state-wide cost for treating hives with miticides in 1990 is $122,343.

Objective 5. Methods of application. Table 4 gives methods of treatment application, number of survey hives in each category, percentage of survey hives in each category, and estimated number of hives state-wide in each category. Menthol was usually put on the top bars, and Apistan® strips were almost always put between hive frames.

Objective 6. Times of application. Table 5 gives times of treatment application, number of survey hives in each category, percentage of survey hives in each category, and estimated number of hives state-wide in each category. Most menthol was used in autumn followed closely by spring. Most Apistan® was used in autumn.

Objective 7. Alternative non-chemical controls. More than half the respondents said the following non-chemical controls were very important or somewhat important in controlling tracheal mites: breeding from their own resistant bees (60.1% favorable responses), using another beekeeper’s resistant stock (65.5%), and "letting the fittest survive" (50.3%). Respondents generally did not favor dark-colored queens (22.5%) or vegetable oil (28.5%). Nevertheless, 8,418 hives were treated with vegetable oil in 1990 (Table 3).

More than half the respondents said that breeding from their own resistant bees (53.8%) and using another beekeeper’s resistant stock (65.3%) were very important or somewhat important in controlling Varroa. Slightly fewer respondents (45.7%) favored "letting the fittest survive".

Objective 8. Estimated yield changes from non-chemical controls. I asked beekeepers to estimate yield changes if they had to rely solely on non-chemical controls. Table 6 gives economic characters possibly affected by non-chemical controls, respondents' estimates of the effect of non-chemical controls, and estimated state-wide changes. If no chemical miticides were available, beekeepers predicted greater loss from Varroa mites than from tracheal mites. Although Varroa mites are not as widespread and fewer hives were treated for Varroa (Table 1), beekeepers perceive Varroa as the greater threat. This reflects the concentration of Varroa in the major beekeeping region of the state and the general inability of honey bees to resist this mite.

Objective 9. Respondents’ personal data and opinions. The average respondent was 55 years old, had kept bees for 16 years, owned 137 hives, and had 6 apiary locations. 90.7% of respondents were male, and 39.4% were college graduates. 41.3% belonged to a local bee organization, and 16.4% belonged to a national bee organization.

I asked beekeepers to indicate their best sources of help and information. These sources were "other beekeepers" (39.2% of responses), "beekeeping magazines" (28.6%), "bee meetings" and "short courses" (7.4%), "Cooperative Extension Ser-

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Table 2. Number of treatments per hive in 1990

<table>
<thead>
<tr>
<th>menthol</th>
<th>Apistan®</th>
</tr>
</thead>
<tbody>
<tr>
<td>frequency of treatment</td>
<td>no.</td>
</tr>
<tr>
<td>in survey</td>
<td></td>
</tr>
<tr>
<td>state-wide</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>6,515</td>
</tr>
<tr>
<td>2</td>
<td>7,317</td>
</tr>
<tr>
<td>3</td>
<td>1,377</td>
</tr>
</tbody>
</table>

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Table 3. Number of Georgia bee hives receiving certain rates of treatment in 1990

<table>
<thead>
<tr>
<th>menthol</th>
<th>Apistan®</th>
</tr>
</thead>
<tbody>
<tr>
<td>rate¹</td>
<td>no.</td>
</tr>
<tr>
<td>in survey</td>
<td></td>
</tr>
<tr>
<td>state-wide</td>
<td></td>
</tr>
<tr>
<td>&lt; 50g</td>
<td>3,057</td>
</tr>
<tr>
<td>50g</td>
<td>5,378</td>
</tr>
<tr>
<td>&gt; 50g</td>
<td>200</td>
</tr>
<tr>
<td>cough drops</td>
<td>2,227</td>
</tr>
<tr>
<td>menthol + oil²</td>
<td>4,000</td>
</tr>
</tbody>
</table>

American Bee Journal

Note: Treatment is limited to use of 50g packet per hive body.

Footnotes:
1 See footnote 1, Table 1.
2 Apistan® is limited to use of 2 strips per hive body.
3 See footnote 2, Table 2.
4 Table of vegetable oil and sugar was used as a control for tracheal mites (K. E. Delaplane, unpublished data).
vice" (6.6%), and "newsletters" (3.7%).

When asked, "Which of the following statements about money and beekeeping best describes your situation?", respondents answered "I lose money" (46.6%), "I break even" (29.1%), "I get extra spending money" (17.3%), "beekeeping is my livelihood" (5.8%), and "beekeeping is an important income supplement" (2.6%).

Respondents were asked, "What is the one biggest problem facing Georgia beekeepers today?". Tracheal mites were the biggest state-wide problem (18%), followed by Africanized bees (9.8%), pesticide kill (8.2%), American foulbrood (7.9%), Varroa mites (3.4%), European foulbrood (1.3%), nosema (1.1%), and chalkbrood (0.8%).

Respondents were asked, "What is the one biggest problem facing Georgia beekeepers today?". Tracheal mites were the biggest state-wide problem (18%), followed by Africanized bees (14%), public misconceptions about the bee industry (10.6%), Varroa mites (7.1%), non-supportive legislation (6.6%), consumer ignorance about honey (6.1%), American foulbrood (14%), public misconceptions about the bee industry (10.6%), consumer ignorance about honey (6.1%), American foulbrood (0.8%), European foulbrood (1.3%), nosema (1.1%), and chalkbrood (0.8%).

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