FORAGING RANGE OF HONEY BEES IN
CITRUS GROVES

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Since Krezdorn and Robinson (1956) reported that cross pollination
of the Orlando tangelo flowers usually resulted in greatly increased yields,
many of these groves have been interplanted with a suitable pollinating
variety. Managers of interplanted groves usually arrange to have colonies
of honey bees placed in their groves since citrus pollen is heavy and sticky
and, like that of most fruit-bearing crops, is not transferred by wind. In
some instances, a beekeeper's desire for additional apiary sites in the
citrus area will induce him to furnish the colonies without a charge, how-
ever, as the demand increases, most beekeepers will insist upon receiving
some payment for the use of their colonies. This is particularly true in
cases where groves are remote or difficult to reach. In the interest of
economy, the grower should not pay for more colonies than necessary, and
the beekeeper should try to locate his colonies so as to facilitate the un-
loading, loading, and routine management operations as much as possible.
There are no exact rules to follow that will assure the most effective use
of honey bees in fruit pollination, but these two suggestions usually are
made: (1) Use at least one colony per acre. (2) Scatter the colonies
singly throughout the grove. However, there is reason to believe that
following these suggestions may not produce the best results in all cases.

A "colony of bees" is not a standardized unit, and as reported by Rob-
inson (1964) one colony can contain two or three times as many bees as
another colony. Therefore, it is meaningless to make a recommendation
in terms of colonies per acre without detailing what is meant by a colony.
In a personal communication, Dr. Adlerz of the Watermelon and Grape
Investigations Laboratory in Leesburg, Florida, reported that the popu-
lation of bees in watermelon fields seems to be regulated more by the
number of open flowers than by the number of colonies placed in the field.
When the concentration of foraging bees reaches the limit imposed by
the number of open flowers in a field, moving additional colonies into that
field does not result in an increase in the number of foraging bees. It is
reasonable to assume that the response of bees in citrus groves would be
similar, and if so, nothing would be accomplished by moving in more
colonies than necessary.

Butler, Jeffree, and Kalmus (1943) suggested that instead of distrib-
uting colonies singly, they should be placed in small groups in several
parts of a grove. They believed that by grouping colonies the concen-
tration of foraging bees would result in such competition that the field
bees would range for greater distances thus giving more uniform coverage
of a grove. Grouping colonies makes them much less of a hindrance to
grove operations, and it also facilitates the moving and routine mainte-
nance operations performed by the beekeeper. It would simplify the bee-
keeper's problems even more if his colonies could be concentrated in fewer

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TABLE 1.—TOTAL NUMBER OF BEES AND NUMBER OF CORDOVAN BEES OBSERVED AT DIFFERENT DistANCES FROM THE EXPERIMENTAL Colonies in 1959.

<table>
<thead>
<tr>
<th>Distance (In Feet)</th>
<th>N</th>
<th>NE</th>
<th>E</th>
<th>SE</th>
<th>S</th>
<th>SW</th>
<th>W</th>
<th>NW</th>
<th>Total</th>
<th>% Cordovan</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>85-8*</td>
<td>77-8</td>
<td>70-10</td>
<td>87-10</td>
<td>79-7</td>
<td>82-9</td>
<td>79-12</td>
<td>84-11</td>
<td>643-74</td>
<td>11.7</td>
</tr>
<tr>
<td>100</td>
<td>91-10</td>
<td>80-9</td>
<td>91-12</td>
<td>92-12</td>
<td>82-11</td>
<td>91-11</td>
<td>91-13</td>
<td>91-10</td>
<td>769-88</td>
<td>12.4</td>
</tr>
<tr>
<td>200</td>
<td>78-10</td>
<td>80-10</td>
<td>90-12</td>
<td>87-12</td>
<td>89-10</td>
<td>78-9</td>
<td>93-10</td>
<td>91-12</td>
<td>686-85</td>
<td>12.4</td>
</tr>
<tr>
<td>300</td>
<td>90-13</td>
<td>86-12</td>
<td>89-11</td>
<td>83-11</td>
<td>**</td>
<td>84-11</td>
<td>37-7</td>
<td>82-8</td>
<td>661-73</td>
<td>12.1</td>
</tr>
<tr>
<td>400</td>
<td>86-10</td>
<td>82-13</td>
<td>85-10</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>90-9</td>
<td>88-9</td>
<td>481-51</td>
<td>11.8</td>
</tr>
<tr>
<td>% Cordovan</td>
<td>11.9</td>
<td>12.8</td>
<td>12.9</td>
<td>12.9</td>
<td>11.2</td>
<td>11.9</td>
<td>11.6</td>
<td>11.5</td>
<td>12.1</td>
<td></td>
</tr>
</tbody>
</table>

*First number is total number of bees observed and the second is the number of cordovan bees.
**Placement of colonies in grove made it impossible to establish sampling stations in these locations.
but larger groups located outside of a grove, and this paper is a report of the results of tests made to determine the foraging range and distribution of honey bees in citrus groves.

Six colonies of honey bees were placed in a 27-acre block of mature Orlando tangelos when the trees were in full bloom in the spring of 1959. As it was necessary to determine which foraging bees were from the experimental colonies, a cordovan (genetically marked) strain of bees was used. This stock was obtained from Dr. O. B. Mackenson, Bee Breeding Investigations Laboratory, Baton Rouge, Louisiana. The colonies were placed side-by-side between the rows, 200 feet in from the south border and equidistant from the east and west borders. Sampling stations were established at 100 foot intervals for distances up to 400 feet from the colonies, in each of eight compass directions. The sampling technique consisted of counting the number of foraging bees while the observer circled one tree at each sampling station. Observations were made four times a day on March 17, 19, and 23. The total number of both normal and cordovan bees observed is listed in Table 1.

In the spring of 1961 a similar series of tests were made in the same Orlando tangelo grove. However, this time the colonies were located along the southern edge of the grove and 27 sampling stations were established in five directions from the colonies at distances of up to 800 feet. Instead of using the genetically marked bees, colonies were marked with fluorescent powders of different colors. The experimental colonies were oriented so that there was one colony facing in each of the four cardinal compass points, and each was marked with a different colored powder. A different color of powder was used each day on which observations were made. Different marking techniques were tried, and best results were obtained by removing the hive cover and blowing a small amount of the powder in the entrance with a small rotary duster (Fig. 1). The bees were dusted at 7:00 a.m. and again at 1:00 p.m. The effectiveness of this method of marking is shown by the fact that fluorescent powder was found on 92 percent of the bees in samples taken from the colonies six hours after they were treated. Ten bees were collected at each sampling station four times a day on March 13 and 17. These bees were examined with an ultra-violet light, and both the total number of bees and the number of marked bees collected at each sampling station is listed in Table 2.

In both 1959 and 1961, foraging bees from the experimental colonies were observed or captured at all sampling stations regardless of the distance or direction from the experimental colonies. Approximately 12% of the bees observed during the 1959 tests and 4% of those captured in 1961 were from the experimental colonies. Under the conditions of these tests, there was no indication that the distance from the colony had any effect on the number of foraging bees. In 1959 an average of 11.8% of the bees observed foraging on trees 400 feet from the colony and 11.7% of those 20 feet from the colony were marked. In the 1961 tests, 3.0% of the bees captured within 50 feet of the hive were marked, and 4.4% at stations 800 feet from the hives.

Parris and Haynie (1950) reported that in watermelon fields, foraging bees concentrated their activities in the direction in which the colonies faced. They reported that the yields of melons were considerably higher
Fig. 1. Mass marking a colony of honey bees with fluorescent powder.

in front of the hive than to the sides or to the rear. In these tests the orientation of the entrance of the experimental colonies in citrus groves had no apparent effect on the direction in which foraging bees from these colonies ranged. In the 1959 tests, all of the colonies faced south yet workers from these colonies were observed foraging in all parts of the grove. In 1961 the colonies were oriented so that there was one colony facing each of the four cardinal compass points, and again workers from each colony were recovered in all parts of the grove.

**TABLE 2.—TOTAL NUMBER OF BEES AND NUMBER OF MARKED BEES CAPTURED AT DIFFERENT DISTANCES FROM THE EXPERIMENTAL COLONIES IN 1961.**

<table>
<thead>
<tr>
<th>Distance (in Feet)</th>
<th>Direction From Apiary</th>
<th>Total</th>
<th>Marked</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>80-3⁴</td>
<td>80-1</td>
<td>80-4</td>
</tr>
<tr>
<td>150</td>
<td>80-5</td>
<td>80-3</td>
<td>80-3</td>
</tr>
<tr>
<td>300</td>
<td>80-2</td>
<td>80-5</td>
<td>80-3</td>
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<tr>
<td>450</td>
<td>80-4</td>
<td>80-3</td>
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</tr>
<tr>
<td>600</td>
<td>80-3</td>
<td>80-4</td>
<td>80-5</td>
</tr>
<tr>
<td>800</td>
<td>**</td>
<td>80-3</td>
<td>**</td>
</tr>
<tr>
<td>Total</td>
<td>400-17</td>
<td>480-19</td>
<td>400-19</td>
</tr>
<tr>
<td>% Marked</td>
<td>4.3%</td>
<td>4.0%</td>
<td>4.8%</td>
</tr>
</tbody>
</table>

*First number is total number of bees captured and the second is the number of marked bees.

**Placement of colonies in grove made it impossible to establish sampling stations in these locations.
The results obtained in these tests indicate that the foraging area of bees in a citrus grove is quite extensive. There is no indication that they concentrated their foraging in the immediate vicinity of the hive, thus it is unlikely that there is any advantage in scattering the colonies singly throughout the grove, instead of concentrating them in larger groups. If the distance is no more than one-fourth to one-third mile between apiaries, the foraging areas should overlap; and if the bee population is sufficient, they will cover the intervening distance adequately.

LITERATURE CITED


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