A Technique for Screening Chemicals to Determine Their Repellency to Honey Bees

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The search for chemical compounds which have repellent properties against the honey bee necessitates a large number of candidate materials and also a large number of honey bees which are willing to "cooperate" in the tests. The first problem is one of providing a place where a large number of materials can be distributed in such a way that all materials are tested equally.

As baits are used to test repellents, the problem of finding bees that are willing to "cooperate" involves timing tests to periods when nectar and pollen-producing plants are in short supply.

It is at these times also that the bee populations are approaching or have reached their peaks. The field force has been busy gathering the available crop for storage and brood rearing. When the supply of raw materials becomes scarce it is reported by the workers and searchers immediately go out in search of a new supply of nectar and pollen. Under these circumstances, bees will more readily feed on sweetened liquids that are provided for them.

In north central Oklahoma where these tests were conducted, two such periods occur annually. The first of these periods occurs during a six-week interval following the fruit blossoming period and continues until the time hairy vetch and sweet clovers start blooming. This period varies from year to year, but it most frequently starts during the first or second week of April and continues until late May or early June.

The second such period comes at the close of the main nectar flow period. In north central Oklahoma or the Stillwater area, this comes during the second and third weeks of July and continues until after frost. Not much in the way of new stores is available after this and that which is available always produces a darker and stronger-flavored honey. At this time the colonies have passed the swarming period and have a large field force with an inadequate source of raw materials to keep them occupied and happy. The bees in search of nectar and pollen sources take sweetened syrups made available to them. During this period, temperatures are near the maximum for the year. In these tests when the temperatures were extremely high, honeybee response to sweetened baits was frequently at a slower rate than noted during the spring periods. Under these circumstances, the bees could be induced to greater activity by sprinkling a small quantity of sugar syrup at the entrance on the landing boards of the hives.

The screening tests were made each year during the periods when pollen sources of the region were in short supply. The sweetened liquids consisted of equal parts, by volume, of sugar and water or a honey water dilution of two volumes of honey in three volumes of water. The repellent candidate materials were diluted with acetone and added to the bait to provide the final standard dilutions of 0.1 percent concentrations. The honey water or sugar syrup baits were mixed with equal volumes of acetone without repellent materials to provide a check on the effectiveness of each material.

The apparatus for offering the baits and repellents consisted of 2" x 2" posts about 6 feet in length (Figure 1). The posts were set up at intervals of twenty feet on the windward side of the bee yard. Each post had four holes 1/16" in diameter drilled into each edge and spaced eight inches apart up and down its edges. A loop just large enough to hold a No. 125, 1 1/4 ounce soufflé cup, was fashioned on one end of a wire. The straight portion of the wire was cut to a length of eight inches and inserted into the previously drilled holes. When in place on the posts, the soufflé cups were held out at a distance of seven inches from the post's edges. Each post had a maximum capacity of twenty-eight individual cups. These could be arranged in various patterns on the posts, viz. at the same level circling the post, up and down one edge or staggered in a circular fashion around the post.

The various combinations of arrangements of the cups were used to force the bees to pick out the untreated cups where the material indicated repellency.

Thirty milliliters of repellent candidate material were placed into three of the cups, the fourth was filled with the untreated bait. Check cups were not always placed in the same relative position to the other baits on the posts. This was done to avoid training or conditioning the bees to come to a certain location to obtain the untreated baits. Additional precautions taken to prevent this training consisted of placing the cups at different heights on the post and not always in a circle at one level around the post. An additional feature in using these posts was that they could easily be moved to an entirely different portion of the bee yard whenever there was any indication of the bees becoming conditioned to one location. The test for each candidate material was replicated five times whenever the quantities were available. Otherwise, replications were reduced to a number consistent with the available materials.

Three or four different materials were tested on a single post. When greater numbers than this were used at one time it complicated keeping the records and greatly increased the chance of error while making and recording the observations.

Readings on the repellency of the materials were obtained by observing the cups at fifteen-minute intervals. Observations consisted of counting and recording the number of bees which had their proboscides in the bait accompanied by the appropriate body movements that indicated they were actually taking the bait into their honey stomachs. The data were recorded for each of the individual cups numbered 0, 1, 2, and 3. Cup numbered 0 always contained the untreated bait and was placed at a randomly selected location on the post.

Additional evidence on the effectiveness of the material was obtained on observing and recording the length of time required to empty the cups of the 30 mls. of the bait. It was found that during a normally active test period the check cups would be emptied in thirty to forty-five minutes. This was also the case with some of the baits containing the repellent candidate materials indicating no repellency. The tests were usually started in the mornings and continued long enough to indicate whether or not the materials had repellent properties. In some instances they were even emptied before the checks. When definite repellency was indicated and the check cups were emptied quickly and activity slowed down, the check cups were refilled at intervals in an attempt to keep the bees interested until the end of the day or even to continue the test into the next day for periods of more than twenty-four hours. At the end of each test the soufflé cups were collected and destroyed and the next test started with fresh cups.

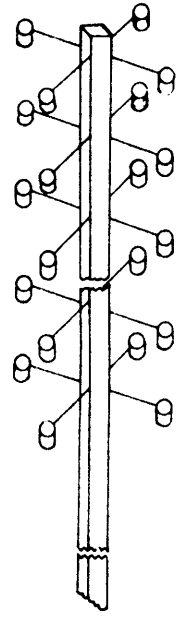

FIG NO 1 BAIT CUP HOLDER