

A bait station for survey and detection of honey bees*

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(Received 26 March 1990; accepted 11 June 1990)

Summary — A bait station was developed in response to needs by regulatory agencies to survey for populations of Africanized honey bees; it is also used in a honey bee abatement system. Bees were attracted with honey and Nasonov pheromone components (1:1 citral:geraniol). A feeder dispensing sucrose solution supported foraging activity sufficient for sampling bees and for abatement activities. Four efficacy tests were conducted using controlled, isolated populations of bees on an island. These and other survey results indicate high baiting efficiency during nectar dearths and favorable flight conditions, but lower efficiency during nectar flows. Properly conducted baiting surveys thus should be effective for detecting honey bees as needed for most regulatory efforts.

***Apis mellifera* / pest management / Africanized honey bee / bait / foraging**

INTRODUCTION

Detecting populations of feral honey bees will be a fundamental aspect of minimizing the threat of Africanized bees to the United States (Stibick, 1984; Rinderer *et al*, 1987; USDA, 1987; Anonymous, 1989). During periods of active foraging, many areas can be surveyed by simply collecting bees from flowers; standard beelining techniques (Edgell, 1949; Donovan, 1980; Visscher and Seeley, 1989; Wenner, 1989) then can be used to locate individual colonies if necessary. At times, however, another method is needed for systematic survey, detection and sampling. This

report describes the design and effectiveness of a bait station which was developed in response to requests for survey technology from federal and state regulatory agencies.

In addition to being a survey tool, the bait station is being used in a system designed to eradicate remotely located colonies of Africanized bees by having foragers deliver lethal doses of insecticide to the nest (Williams *et al*, 1989). There are broader possible applications of such an abatement system: eradicating point infestations of bee pests or diseases (Kamler and Titera, 1982; Titera *et al*, 1987); rendering areas bee-free to enable isolated

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matings for breeding purposes; or eliminating honey bees when they simply are considered to be pests (as is the case in many national parks in Australia) (BP Oldroyd, personal communication). Recent *Varroa* infestations in the United States have prompted requests for eradication technology by state regulatory administrators. In any application, successful eradication using the acephate baiting system is founded on effective baiting.

MATERIALS AND METHODS

Equipment

The bait station consisted of a feeder and an attractant set on a stand (fig 1). The feeder was a 946-ml (1 qt) polyethylene cup (eg, Genpack Corp* No 31032, Glen Falls, NY 12801) with a snap-on lid. Four 1-mm holes were drilled through the cup at equal intervals around the rim 9 mm below the lip (*ie*, level with the bottom of the lid when it was in place). The feeder was filled with 50% (vol:vol) sucrose solution, closed, and inverted on the stand. Such a feeder typically was emptied in ca 2 days of maximum foraging, *ie*, when 200–250 bees were counted at the feeder at any time. Foragers usually returned to a refilled feeder within hours if the feeder had been empty for no more than several days.

The feeder cup was painted bright yellow ("sunshine" yellow; Ace Hardware Corp, color No 17013, Oak Brook, IL 60521) and had blue or black "nectar guides" to help attract and orient foragers (fig 1). A 25-cm yellow plastic saucer was inverted over the feeder to provide shade and protection from rain.

Honey and a mixture of synthetic Nasonov pheromone components were used as attractants. Ten or more ml of honey was smeared on the sides of the feeder can and on the cover. Honey alone was used in some early surveys, but adding Nasonov components often improved attractiveness (unpublished observations; EA Sugden, personal communication). The pheromone mix (0.8 ml of 1:1 ci-

tral:geraniol) was dispensed onto a small piece of cellulose sponge inserted into a 1.5-ml polypropylene microcentrifuge vial. The unsealed vial was secured directly beneath the feeder.

A durable stand for the feeder was a modified 2-m section of 1.3-cm-diameter concrete-reinforcement rod with a "V"-shaped platform bent at the top (fig 1). The bottom of the stand was driven into the ground. A ring of sticky barrier (eg, Tack Trap® Animal Repellents Inc, Griffin, GA 30223) around the rod protected the feeder from ants. The cost of a bait station, using the hardware and attractants listed above, was ca \$ US 1.80.

Efficacy tests

During development of the bait station from 1986–1989, baiting effectiveness was evaluated by conducting numerous surveys for honey bees in different ecosystems and under different nectar flow conditions. Preliminary indications of effectiveness were encouraging, but actual levels of the bee populations being surveyed were unknown. Baiting efficacy therefore was tested under controlled conditions using known colony densities.

The tests were conducted on Grand Terre Island, a 2.4-sq km barrier island in southeast Louisiana (fig 2). The island is predominantly saline marsh fronted by a low, washover terrace with mixed vegetation. There were no feral hon-

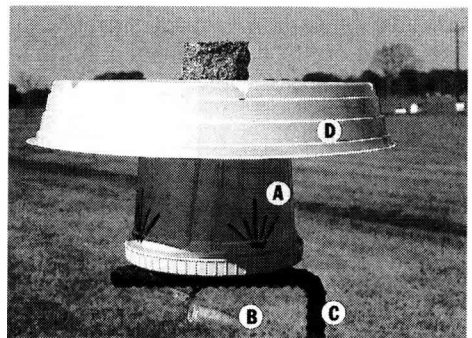


Fig 1. The bait station, showing all major components. A, feeder cup (note 'nectar guides' leading down to a feeding hole, and honey dripping down side); B, pheromone lure; C, stand; D, cover weighted into place.

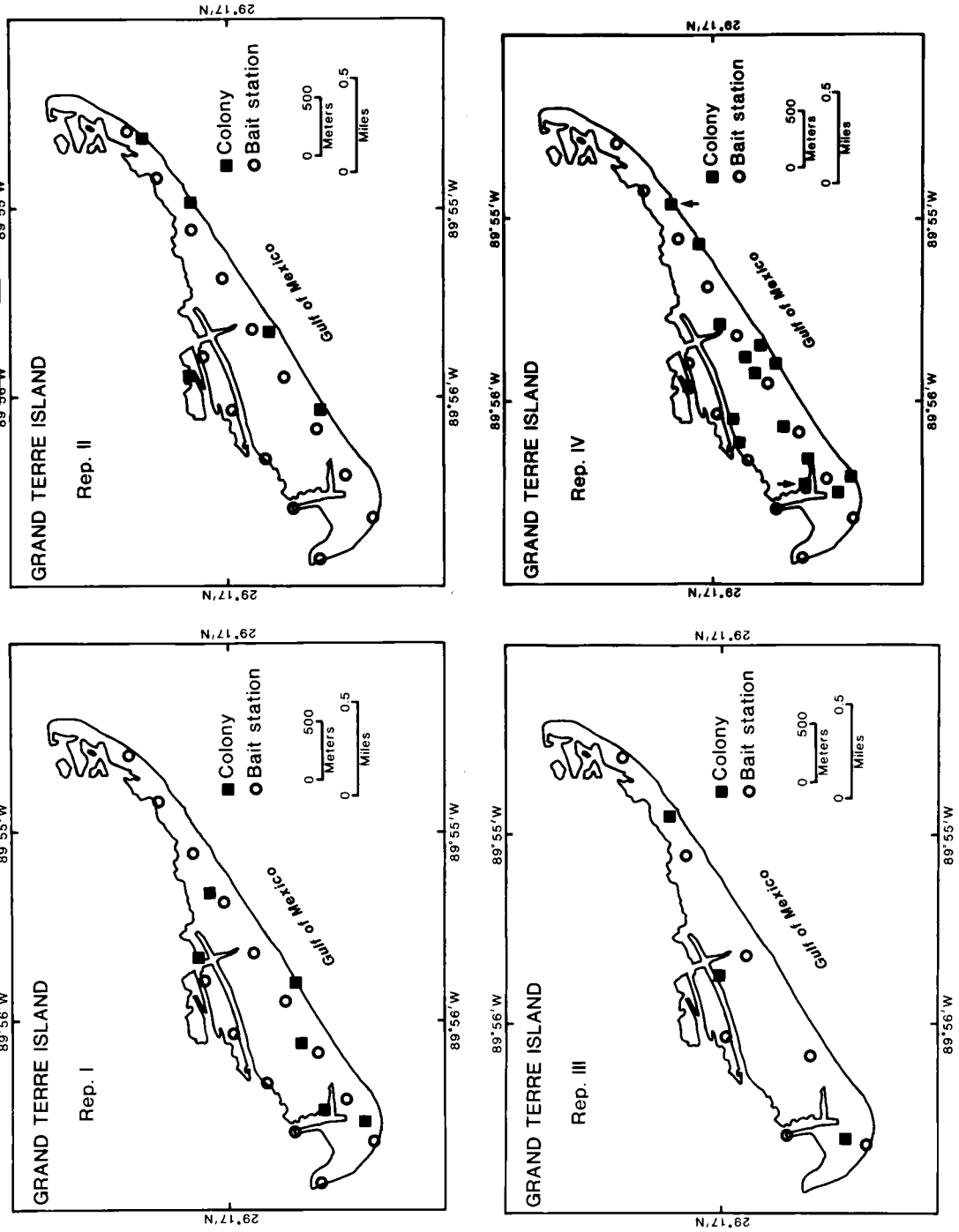


Fig 2. Arrangement of colonies and bait stations during controlled colony density tests on Grand Terre Island, Louisiana. Open circles represent bait stations. Squares represent colonies. The arrows in replication IV indicate the only two colonies which were not found at bait stations within 6 days of censusing.

ey bee colonies on the island. Four replications of bait station efficacy were conducted from April-July 1989.

Grids at 500-m and 250-m intervals were superimposed on the island. Individual colonies were assigned randomly to the centers of quadrants within the 250-m grid sectors (fig 2). Colony size and density varied during the test as follows: replication I, 6 colonies of ca 18 000 bees each; replication II, 5 colonies of 18 000 bees each; replication III, 3 colonies of 50 000 bees each; and replication IV, 15 colonies of 30 000 bees each. Colony densities ranged from ca 1–7/km², which approximates documented feral colony densities in several areas of the United States (Taber, 1979; Visscher and Seeley, 1982, 1989; Wenner, 1989; Morse *et al*, 1990). Nectar flow conditions were monitored by colony weight changes or by nectar storage in combs.

Bait stations usually were placed at the 14 500-m grid intersections (fig 2). In the replication III, 7 bait stations were placed 1 000 m apart along 2 transects that were 500 m apart (fig 2). Baits were checked for foraging activity or evidence of foraging (*ie*, syrup depletion) every 1–6 days. Visitation of baits by individual colonies was determined by vanishing bearings of departing foragers or by marking bees at baits and then searching colonies for marked bees.

RESULTS AND DISCUSSION

Preliminary indications of bait station efficacy were obtained from surveys in a va-

riety of habitats in Louisiana, Texas, Venezuela and Mexico. During nectar dearths, the bait station enabled detection and sampling of many feral and managed bee colonies in favorable bee habitats; baiting also resulted in discovery of rare colonies in unfavorable habitats (*eg*, in the saline marsh of coastal Louisiana). Conversely, feeders were poorly visited during nectar flows and when conditions for bee flight were poor.

Using controlled colony densities on Grand Terre Island, 27 of 29 experimental colonies were found to be visiting bait stations within 6 days after the start of monitoring (table I). The 2 exceptions (fig 2) occurred during the final replication when nectar availability, especially from black mangrove (*Avicennia geminans* (L) L), increased markedly. Colonies on the island initially discovered baits located near their nests, but most or all baits were visited after 1–2 weeks (table I). The furthest distance at which visitation was observed was 1.5 km (in replication III). Similar patterns of bait discovery and visitation recently have been obtained during a baiting study of comparable design in Texas (unpublished observations).

Collective experiences indicate that, given conditions favorable for flight, the bait station is capable of quickly detecting populations of honey bees during nectar

Table I. Discovery and visitation of bait stations by honey bee colonies isolated on Grand Terre Island, Louisiana. The body of the table shows numbers of colonies found visiting feeders on the indicated day after the start of each replication; juxtaposed values in parentheses are cumulative numbers of bait stations visited during the replication.

Replication, start date	No colonies	No bait stations	Days after start					
			1	4	5	6	12	26
I, 6 April 1989	6	14	1(1)	–	–	6(8)	6(13)	–
II, 28 April 1989	5	14	1(2)	–	–	5(10)	–	–
III, 28 May 1989	3	7	1(3)	–	3(7)	–	–	–
IV, 23 June 1989	15	14	6(6)	13(14)	13(14)	13(14)	–	14(14)

deaths, even when colony density is low. The effectiveness of baiting (measured on Grand Terre Island as 93% of colonies detected within 6 days overall, and 100% of colonies quickly detected during deaths) suggests that the technique is useful for survey, detection and sampling of honey bees for regulatory purposes. For critical surveys, higher bait density could be used. On Grand Terre, a maximum of ca 6 bait stations/km² were used; the relatively low cost of bait stations may allow the use of more baits per unit area. It also might be worthwhile to search further for maximally effective olfactory and optical attractants. In preliminary evaluations, however, honey was a better attractant than were several essential oils, pheromone components and comb (unpublished observations; RL Hellmich, personal communication). Kamler and Titera (1982) and Titera *et al* (1987) used honey and old comb to attract honey bees for area-wide eradication.

The major difficulty in baiting bees during favorable flight conditions appears to be competition from natural nectar sources. Knowledge of local nectar flows and careful monitoring of flows is therefore necessary to avoid futile baiting attempts. With increasing nectar availability, fewer feeders are used by fewer bees, and collecting bee samples for identification becomes easier off flowers. Similarly, the use of the feeder for insecticide delivery (see *Introduction*) becomes impractical during nectar flows; alternative strategies may need to be developed to fill this void.

ACKNOWLEDGMENTS

J Baxter, CD Brister, L Beaman, E Jensen, G Perrone, JA Stelzer and D Winfrey helped develop the bait station and conduct efficacy tests. AM Collins and RL Hellmich initiated baiting

studies with Africanized bees and undertook preliminary tests on some attractants. We thank the personnel of Lyle S St Amant Marine Laboratory of the Louisiana Department of Wildlife and Fisheries for the use of their facilities. K Debusschere and K Westphal of the Louisiana Geological Survey provided information and maps of Grand Terre Island. B Navrátil kindly translated an article from Czechoslovakian. This research was completed in co-operation with the Louisiana Agricultural Experiment Station.

Zusammenfassung — Eine Köderstelle zum Aufspüren und Überwachen von Honigbienen. Die Köderstelle wurde vor allem zur Überwachung von Populationen der afrikanisierten Honigbiene entwickelt, aber auch in einem System zur selektiven Bekämpfung von Honigbienen (Williams *et al*, 1989) eingesetzt. Die Bienen wurden mit Honig und Nasonov-Pheromon-Komponenten (Citral:Geraniol 1:1) angelockt. Ein Futterautomat mit Saccharoselösung hielt die Sammelaktivität aufrecht, damit die Bienen gesammelt oder bekämpft werden konnten. Vier Effektivitätstests wurden mit kontrollierten, isolierten Bienenpopulationen auf einer Insel durchgeführt (Dichte ca 1–7 Völker/km²; Köderstellen in einem Areal von 500 x 500 m oder 1000 x 500 m). Insgesamt 27 von 29 Völkern wurden innerhalb von 6 Tagen nach dem Beginn der Überwachung zu einer Zeit, wo das Nektarangebot gering war, aufgespürt. Zwei Völker wurden nicht so schnell entdeckt, vermutlich weil das Nektarangebot zunahm. Dieses und andere Überwachungsergebnisse weisen darauf hin, daß Köderstellen eine hohe Effektivität besitzen solange das Nektarangebot knapp und die Flugbedingungen gut sind, aber weniger effektiv, wenn es ein reiches Nektarangebot gibt. Es sollte daher möglich sein, durch eine gut geführte Köderstelle zu einer ausreichend effektiven

Überwachung von Honigbienen zu gelangen.

***Apis mellifera* / Seuchenbekämpfung / afrikanisierte Honigbienen / Köder / Sammelaktivität**

Résumé — Une station-appât pour dépiéster et surveiller les abeilles. Une station-appât a été mise au point principalement pour surveiller les populations d'abeilles africanisées, mais elle est également utilisée dans le cadre d'un système de destruction sélective de l'abeille (Williams *et al*, 1989). Le miel et les composants de la glande de Nasonov (citrals:géranol 1:1) ont été utilisés comme attractifs. Un nourrisseur offrant une solution de saccharose permettait une activité de butinage suffisante pour l'échantillonnage et/ou la destruction des abeilles. Quatre tests d'efficacité ont été faits sur des populations d'abeilles contrôlées et isolées sur une île (densités d'environ 1–7 colonies/km²; stations-appât situées dans une aire de 500 x 500 m ou de 1 000 x 500 m). Au total 27 des 29 colonies ont été détectées dans les 6 premiers jours lorsqu'il n'y avait pas ou peu de nectar disponible. Deux colonies n'ont pas été découvertes rapidement, probablement parce que la disponibilité en nectar augmentait. Ces études de surveillance, ainsi que d'autres, montrent que l'attraction par appât est très efficace quand il y a pénurie de nectar et des conditions de vol favorables, mais que l'efficacité est réduite pendant les miellées. Il devrait donc être possible de parvenir à une surveillance efficace des abeilles à l'aide de stations-appât bien gérées.

***Apis mellifera* / abeille africanisée / butinage / appât / lutte / antidépredateurs**

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