Proceedings of the American Bee Research Conference

The 1987 American Bee Research Conference was held at the Agricultural Center of Louisiana State University on October 6 and 7, 1987. The third conference will be held at Weslaco, Texas on October 12 and 13, 1988. Abstracts of the proceedings follow.

1. Bram, R. A.[a] – THE USDA-ARS RESEARCH PROGRAM ON AFRICANIZED HONEY BEES – A major effort has been made to marshal a comprehensive Agricultural Research Service (ARS) research program on the control of Africanized honey bees in support of the domestic and international programs of the USDA Animal and Plant Health Inspection Service (APHIS). This program of research encompasses component activities at each of our major honey-bee research laboratories.

Research at the Baton Rouge, Louisiana, Honey Bee Breeding, Genetics, and Physiology Laboratory is designed to better understand the biology of Africanized honey bees and thereby improve the techniques for their control. Scientists are guided by three objectives: (a) to evaluate the effects of genetic selection and dilution in European and Africanized stock; (b) to quantify pollination, honey production, and other important behavior patterns; and (c) to develop barrier and control techniques which prevent or retard spread of feral colonies.

Research emphasis at the Carl Hayden Bee Research Center, Tucson, Arizona, is on devising new techniques for the detection and attraction of feral Africanized honey bees. The objectives of this research are: (a) to develop and evaluate remote sensing instrumentation for detection of honey bee activities in hives and in the field; (b) to construct a computer simulation model for predicting the outcome of free-flight matings; and (c) to develop bait hive technologies.

At the Honey Bee Research Laboratory, Weslaco, Texas, research is focused on developing methods for the management of Africanized honey bees and on learning more about their role in disseminating tracheal mites. The objectives are: (a) to develop baseline data on feral and managed honey bee populations in Northern Mexico; (b) to detect and quantify changes that occur in populations stressed with Africanization for use in developing management strategies; and (c) to assess the potential role of Africanized bees in the spread of tracheal mites.

The Beneficial Insects Laboratory, Beltsville, Maryland, concentrates on Africanized honey bee identification research and taxonomic services. Objectives of these activities are: (a) to refine morphometric techniques for use in analyzing the process of Africanization; (b) to discover and apply new techniques for Africanized bee identification; and (c) to provide authoritative identification services for APHIS seven days a week.

With the recent agreement to implement an integrated plan to retard the northward migration of Africanized honey bees in Mexico, it is important that increased attention be given to coordinating USDA-ARS Africanized honey bee research activities with other scientists, action agencies, the bee industry, and the public at large. Drs. T. E. Rinderer and H. Shimanuki have been assigned the responsibility for coordinating research on Africanized bees. Dr. Shimanuki is responsible for assuring that the ARS Africanized bee research program is closely attuned to the needs of the action program in Mexico and that it complements similar research with university cooperators. In addition, Dr. Shimanuki maintains liaison with other USDA agencies and the bee industry. Dr. Rinderer continues to have responsibility for the technical direction of the ARS research program on Africanized bees at Baton Rouge, Louisiana, and its associated worksite in Venezuela. He also actively coordinates this work with other ARS Africanized bee research being conducted in Arizona, Texas, Maryland, and Mexico.

2. Cal, M.[b] and D. F. Mayer[c] – TRACHEAL MITES AND AFRICANIZED HONEY BEES IN BELIZE – The tracheal mite *(Acarapis woodi)* has not been found in previous limited surveys of honey bee colonies in Belize. The mite has been found in Mexico near the Belize border and in other countries of Central America.

During the summer of 1987, we conducted a survey for the presence of tracheal mites in Belize. No mites were found in any of the 4,301 bees dissected. Worker honey bees were collected from the top super or from the front of the hive from 234 colonies in 66 different apiaries throughout Belize. In apiaries with fewer than 15 colonies, 50 bees were collected from each of 3 colonies and put in the same vial. In apiaries with more than 15 colonies, 50 bees were collected from each of 5 colonies and put in the same vial. Honey bees were also collected from one swarm confirmed as Africanized and two swarms suspected as Africanized. All bees were preserved in alcohol. Honey bees from each sample were dissected, the thoracic disc cleared in KOH, and the trachae examined for mites under a dissecting micro-

scope. If there were fewer than 100 bees in the sample, all bees were dissected; if there were more than 100, only 100 were dissected.

The Africanized bee is established in Mexico and Guatemala near the Belize border. It is apparent to most beekeepers of Belize that Africanized bees will become established in Belize. The reported number of swarms destroyed by the Apiary Unit and extension personnel has been increasing. Since May of 1987, when the Africanized bee was first detected in the Toledo District, swarms of Africanized bees have been captured in the Corozal District. In March of 1987, the Department of Agriculture-Belize and the Secretaría de Recursos Hydraulicos (SARH) of Mexico initiated a joint program for control of Africanized bees.

Since the beginning of the program, over 1000 traps of Mexican design have been placed close to the main roads of the country. Traps of different colors (blue, yellow, green, white) were baited with special attractants to attract bee swarms. The method was very effective. By August, 343 Africanized swarms were caught in the traps.

3. Collins, A. M.[d] – COMPARISON OF COLONY DEFENSE BY EUROPEAN, HYBRID (E X A), AND MIXED HONEY BEE COLONIES – Our previous work has shown that Africanized honey bees are excessively defensive (*Science* 218:72-74) and that hybrids of various European varieties with Africanized bees are intermediate to the two parental types (*J. Apic. Res.*, in press). Neither of these types are acceptable for use by U.S. beekeepers.

Hellmich *et al.* (*J. Econ. Entomol.*, in press) demonstrated effective control of matings of European queens in Africanized areas by saturating the local drone population with desirable European drone types. They predicted that in most cases no more than 10% of the matings would be to Africanized drones if a reasonable number of drone production colonies were placed in the mating apiaries. The question posed here is whether 10% mismating will produce colonies that are unacceptably defensive.

Three types of colonies were used for these comparisons, European, hybrid, and mixed. The European colonies were from queens of eight U.S. commercial types. The hybrid colonies were from supersedure queens of the same commercial types that had mated in an Africanized area. Mixed colonies were produced by adding hybrid brood equivalent to 10% of the average amount to European colonies every eight days for eleven weeks prior to testing.

The colonies were then assayed using a standard test sequence (Collins & Kubasek, *Ann. Entomol. Soc. Am.* 75:383-387). The results presented in the table indicate that there were significant differences for the time to respond to the moving target, the number of stings in the target, and number of bees in the air. The hybrids were always most defensive. The mixed colonies were only slightly more defensive than the European colonies. Therefore, this level of mismating would still produce acceptable colonies for beekeepers.

Table – Significant differences in the level of defensive responses by European, hybrid (E x A), and mixed (90% European and 10% hybrid) colonies of honey bees. Number of colonies of each type = 16. Means ± std. error. Means followed by like letters are not significantly different.

Bee type	Time to respond to moving target	Number of stings in the target	Number of bees in the air
European ..	13.8 ± 9.5a	5.3 ± 7.4c	25.4 ± 18.5f
Mixed	12.9 ± 10.2a	10.7 ± 14.8d	30.2 ± 18.3f
Hybrid	6.5 ± 6.7b	32.6 ± 42.1e	40.6 ± 29.3g
F	12.8	20.61	6.8
Prob	<.01	<.01	<.01

4. Cox, R. L.,[f] J. O. Moffett,[f] and M. Ellis[g] – HONEY PRODUCTION, COLONY SIZE AND MITE INFESTATION LEVELS OF HONEY BEE COLONIES TREATED WITH MENTHOL – Honey bee (*Apis mellifera* L.) colonies infested with tracheal mites (*Acarapis woodi*) were treated with crystalline menthol to determine its effect on the bee population, honey production and mite population of colonies in a migratory beekeeping system.

On April 1 bee colonies infested with *A. woodi* were split to make 5-frame nucleus colonies housed in single deep hive bodies near Weslaco, Texas. New Italian queens from California were introduced into each colony. Thirty-two of the colonies were treated with a 25-gram menthol cake and sixteen were left untreated. Menthol cakes were prepared by melting 25 grams of menthol crystals in a petri dish. A solid flat cake was formed when the liquid menthol cooled. The cakes were placed on the top bars of treated colonies on April 8. Sixteen colonies were treated in this manner for 12 weeks, 16 for seven weeks and 16 received no menthol treatment. On May 14 a second hive body was added to each colony. On May 30, the colonies were moved to two apiary sites near York, Nebraska, and two shallow supers were added to each hive.

Samples of worker bees were collected from the colonies on April 10, May 11, May 30, and July 8 for the purpose of examination for *A. woodi*. Colony population size (frames of adults and square inches of sealed brood) was recorded on May 14, July 8, and Sept. 16. The colonies were weighed May 30, July 8, and Sept. 16 to determine the amount of honey stored. Samples of honey, wax, and adult bees were collected from all colonies on May 19, and July 8 for detection of menthol residues. Menthol cakes were weighed before placement in the hive, and when they were removed to determine the amount of menthol vaporized during treatment.

The mite infestation level was greatly reduced by 7 weeks of menthol treatment (from 25.6% to 1.6%), while the infestation level decreased only slightly in untreated colonies (22.6% to 18.8%). At the end of 12 weeks of menthol treatment (July 8), both treated groups averaged less than 0.26% infestation, but 2.6% of the bees in the untreated group were still infested.

Colonies treated for 12 weeks had the largest populations (brood and adult), but they registered the smallest weight gain during the study in Nebraska (Table). The differences between bee populations and colony weight gains were not statistically significant (α = .05). Although we did not demonstrate a statistically significant effect, menthol may have a detrimental effect on nectar foraging and/or storage behavior of honey bee colonies when used as a spring treatment.

Table – Mean Area of Sealed Brood, Frames of Adult Bees, and Weight Gain of Honey Bee Colonies Near York, NE During the Period (5/30-9/16/87) After Treatment with Crystalline Menthol.

Treatment	Sealed Brood (in^2)	Adults (frames)	Colony Weight Gain (lbs.)
No Menthol.....	408.9a*	24.25a	78.9a
19.98g Menthol..... (Vaporized over 7 weeks)	370.7a	18.64a	71.1a
36.96g Menthol..... (Vaporized over 12 weeks)	445.8a	21.88a	56.5a

*Means followed by the same letter in the same column are not significantly different at the 0.01 protection level according to Duncan's New Multiple Range Test (Steel and Torrie, 1960).

5. Danka, R. G.[d] – FLIGHT CHARACTERISTICS OF FORAGING AFRICANIZED AND EUROPEAN HONEY BEES – Movements of individual foraging Africanized (AHB) and European (EHB) honey bees were compared as part of a larger effort assessing AHB as crop pollinators. Bees were observed as they foraged for nectar and pollen in a large field of sesame (*Sesamum indicum*) near Acarigua, Portugesa, Venezuela. Two managed colonies of light yellow EHB were moved to the site; these bees were easily dis-

tinguishable from dark, striped, feral AHB which were abundant in the area. Randomly chosen foragers of each bee type were followed until they were lost from sight or three minutes had elapsed; bees watched for three minutes usually were captured for morphometric identification. Flight data were recorded onto audio tape. For each flower visit by a bee, observations included time visit began, resources collected (*i.e.*, nectar, pollen, both or neither), time visit ended, movement direction and movement distance (to nearest 10 cm). A total of 118 AHB and 101 EHB were observed.

Preliminary results (Table) generally indicate that AHB moved faster and further than EHB while foraging, a trend consistent with anecdotal reports of AHB flight patterns. Differences between the bee types at the level of individual foragers, however, were relatively small (<20%). Other foraging studies have shown that much larger differences exist at the level of the colony (Danka *et al.*, *Apidologie* 17:193-202; *Animal Behavior*, in press). Colony-level parameters are thus probably the more important foraging traits to be considered when selecting and breeding bees for pollination. For AHB, however, management considerations may be of paramount importance in agricultural pollination systems (Danka *et al.*, *J. Econ. Entomol.* 80:621-624).

Table – Visitation and movement parameters ($\bar{x}$ ± sd) exhibited by Africanized and European honey bees foraging in sesame. Data summarize portions of foraging bouts (see text).

Parameter	Bee type		Prob > t
	Africanized	European	
Flowers visited	10 ± 5	10 ± 4	-
Duration of flower visits (sec)	9.6 ± 3.9	11.8 ± 6.1	0.001
Duration of interfloral moves (sec)	4.6 ± 1.8	5.1 ± 1.9	0.033
Cm/interfloral move	50 ± 29	47 ± 28	-
Flowers visited/min	4.9 ± 1.4	4.5 ± 2.8	0.001
Cm travelled/min	210 ± 146	178 ± 124	0.050
Index*	1124 ± 1195	947 ± 1196	0.014
% visits for:			
nectar	22	38	-
pollen	51	38	-
nectar and pollen	21	19	-
empty	6	6	-
% inter-row moves	34	34	-

* Index = (flowers visited/min X (cm travelled/min). This measure is included to test for bees which tended to both visit more flowers and move greater distances while foraging; a combination of these traits is probably desirable for efficient pollen dispersal.

6. Dietz, A.,[h] D. S. Hurley,[h] J. S. Pettis,[f] and F. A. Eischen[h] – CONTROLLING *ACARAPIS WOODI* (RENNIE) IN PACKAGE BEE COLONIES WITH APITOL® – Forty-two packages of honey bees (2 lbs.) were obtained from 22 colonies infested with *Acarapis woodi*. Infestations ranged from 60 to 100%. Each package was provided with a mated queen and 550 ml of treated or untreated 50% (wt/wt) sucrose syrup. All treated colonies received syrup containing either 0.5 mg/ml (group B) or 1.0 mg/ml (group C) of cymiazole (2-[2,4-dimethylphenyl-imino]-3-methyl-4-thiazoline hydrochloride), Apitol® (GRA. 17.5% cymiazole) Ciba-Geigy Ltd. The control (group A) consisted of 10 packages of bees and the treatment groups B and C of 16 packages each.

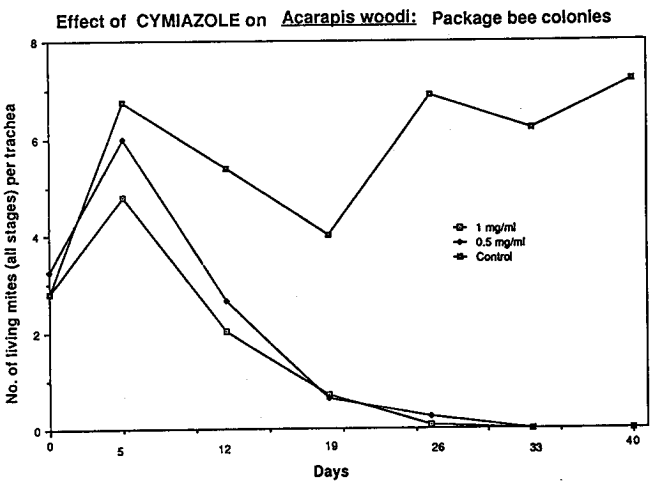
After installation on frames free of nectar and pollen, package colonies were examined at weekly intervals to determine food consumption, brood production and bee mortality. Random samples of ten bees/colony were examined on days 5, 12, 19, 26, 33 and 40. On day 0 only 5 bees were examined. Dissections and live mite determinations were made according to Eischen *et al.* (*Am. Bee J.* 127:99-101).

There was a large increase in the number of mites of all stages during the 5-day holding, or customary shipping, period (see figure). The clustering of bees encountered during this period may have facilitated an easy transfer and distribution of mites between the package bees because there were many young bees with numerous young female mites ready to lay eggs at this time. Another possible explanation for this increase in the size of the mite population (see figure) is that the rate of success of dispersing females was very high because very few founding females were lost and thus unable to locate a new host under such crowded conditions.

Mite survival in groups B and C was less than 1 live mite/trachea after 14 days. After 26 days, no live mites were found in the tracheae of treated package bees. In the control, the highest infestation was recorded on day 40 (see figure).

Concentrations of 0.5 mg/ml and 1.0 mg/ml were detrimental to some honey bee larvae as spotty brood patterns were observed in several colonies. The effect was more pronounced at the higher concentration. Bees in treatment groups B and C utilized/hoarded an average of 654 ml and 526 ml per colony, respectively, while bees in the control group (A) removed all of the 2000 ml of syrup offered.

The efficacy of cymiazole was apparent after 7 days, and almost complete control of mites was recorded after 26 days. Since the bees did not readily utilize and hoard the treated syrup used, relatively small amounts of Apitol® appear to be necessary to control *Acarapis woodi*.



7. Dooley, J. B.[i] and H. T. Kerr[i] – THERMODYNAMIC MODELING OF A HONEY BEE – An engineering analysis of the honey bee was conducted to provide a physical science basis for some observed behaviors of the honey bee.

A worker honey bee was modeled as a thermo-mechanical system and as an aircraft. Careful consideration was given to the anatomical features that significantly contribute to heat generation and heat removal for a honey bee engaged in various activities. Also, the relative worth of nectar versus honey as a fuel for bees was determined for different environmental conditions. Using this model and data base, a series of "mission analyses" were used to determine the limiting conditions under which the honey bee could provide necessary control of its body temperature. For example, these analyses showed that the honey bee has anatomical mechanisms for maintaining thoracic temperatures necessary for flying as long as the air temperature is above about 48° F. At the other extreme, honey bees flying in warmer air can use those same anatomical mechanisms to control the rate of body heat removal so that body temperatures remain tolerable. However, as the air temperature exceeds about 110° F, the honey bee has reached its upper limit on normal heat rejection. Without additional cooling,

bees flying in air warmer than 110° F would quickly have elevated body temperatures that would cause their blood to congeal. However, if the bees have water or very dilute nectar in their crop, they can regurgitate the liquid during flight for emergency cooling. The liquid would spray back over their body and result in evaporative cooling which would also deposit any dissolved sugar onto the body hair. This analysis could explain why bees in hotter climates use large amounts of water and may prefer dilute nectars. These analyses demonstrate that strong thermodynamic bases exist for observed behaviors of honey bees, and suggest that further insights might be realized by additional physical science analyses.

8. Eischen, F. A.,[h] D. Cardoso-Tamez,[w] A. Dietz,[h] and G. O. Ware[m] — APITOL, A SYSTEMIC ACARICIDE FOR THE CONTROL OF *ACARAPIS WOODI*: AN APIARY TEST — Three groups of honey-bee colonies (N = 30) located in northeastern Mexico were selected on the basis of the prevalence of *Acarapis woodi* parasitizing their workers. Lightly (≤ 10%), moderately (20-60%), and heavily (90-100%) infested colonies were randomly assigned to control or treated subgroups (N = 15). Controls received 50% sucrose syrup, and treated colonies received syrup medicated with 0.3 mg/ml of cymiazole (2-[2,4-dimethylphenylimino]-3-methyl-4-thiazole-hydrochloride, Apitol®, Ciba-Geigy Ltd.) small, medium, and large colonies received 300, 600, and 1000 ml of syrup, respectively. Syrup was fed three times at weekly intervals.

At the end of treatment, the parasite load scores in medicated colonies were 0.53, 0.84, and 0.63 in the lightly, moderately, and heavily infested groups, respectively. This compared with 2.25, 3.43, and 1.13 parasite load scores of the control colonies of the same groups, respectively ($P < 0.05$). In each group, some colonies did not respond typically to medication. High mite populations at the end of the test were associated with large colony size and large food reserves at the beginning of the test. Increased dosages, as well as redistribution/reduction of food reserves are recommended for greater efficacy.

Unexpectedly, medicated colonies had significantly larger bee populations than controls at the end of the test ($P < 0.05$). Increased bee longevity due to parasite load reduction is suggested as the cause.

9. Ellis, M. D.,[g] and C. Simonds[g] — MENTHOL FUMIGATION OF CAGED HONEY BEES TO PREVENT THE SPREAD OF TRACHEAL MITES IN PACKAGE AND QUEEN BEE SHIPMENTS — The introduction of *Acarapis woodi* into the United States has disrupted the normal shipment of package and queen bees. Preliminary results indicate that menthol fumigation of caged bees in a temperature controlled fumigation chamber rapidly kills adult mites at the highest temperature and exposure time tested, and that most immatures and eggs do not develop into adults following treatment.

All adult mites were killed in honey bees exposed to menthol fumes for 36 hours (24 hours at 95° and then 12 hours at 100° F), and over 95% of the nymphs were killed (treatment 3 of Table). After 8 days, all the adult and nymphal stages of mites were dead in honey bees exposed to treatment 3. With further study of the temperature and exposure time variables, this method has promise as a means of treating caged bees destined for shipment to prevent the spread of *Acarapis woodi*.

Table — Time, temperature, and treatment needed to kill mites

Treat. Number	Live adults	Dead adults	Live nymphs	Dead nymphs	Turgid eggs	Flat eggs
1	10	4	4	6	6	0
2	0	22	20	23	20	4
3	0	40	1	21	6	6
4	28	1	13	16	29	1

TRT 1 — 8 hrs. at 95 F. menthol exposure.
TRT 2 — 24 hrs. at 95 F. menthol exposure.
TRT 3 — 24 hrs. at 95 F. plus 12 hrs. at 100 F. menthol exposure.
TRT 4 — 24 hrs. at 95 F. plus 12 hrs. at 100 F., no menthol.

10. Estrada, O.,[j] J. O. Moffett,[f,] R. L. Hellmich,[d] and R. Rivera[f] — MANAGING AFRICANIZED HONEY BEES IN VENEZUELA — Octavio Estrada, the senior author, is a third generation beekeeper, whose grandfather had 1,800 rustic hives and whose father was a partner in Miel Acapulco. Currently he is production manager for Miel Carlota of Cuernavaca, Morelos, Mexico. He and his 44 employees manage 18,000 colonies for honey production; and each year they rear 60,000 queens and sell 17,000 nuclei. Estrada also manages several hundred of his own colonies.

Miel Carlota is experimenting with different methods of managing Africanized bees in Venezuela in order to prepare for their arrival in Morelos. In early 1988, the company plans to establish apiaries in the state of Chiapas, Mexico for first-hand experience.

Octavio on a trip to Venezuela found Africanized bees very defensive. At one time he received 62 stings in 30 seconds when he placed his unprotected hands near a hive entrance. In one apiary, he received 10 stings on his ear when the veil rubbed against his face. Estrada has been going to bee yards since he first accompanied his father when he was five. He had never worn gloves or coveralls prior to this trip to Venezuela.

Listed below are important recommendations and general information for beekeepers who intend to work with Africanized bees:

1. Each colony should be placed on an individual stand. When several colonies are placed on the same stand, working one colony usually disturbs the others.

2. Colonies should be spaced at least two meters apart; and directions of their entrances should be alternated.

3. Apiaries should be located at least 300 meters from livestock and places where people live or congregate, and should be placed near trees, shrubs, or high grass so that the bees are forced to fly above head level when leaving and entering the apiary.

4. Veils should be painted white and should have ear flaps. This reduces the number of Africanized bees striking the veil and prevents the bees from stinging through the veil.

5. Two people should inspect a colony because smoking Africanized bees is a full-time job. A reliable smoker with a large fuel capacity should be used during these inspections. When entering an apiary, the colonies should be approached from the side so that guard bees are not alerted.

6. Amount of time to inspect a colony should be kept to a minimum in order to control defensiveness and robbing.

7. Consider working colonies at night. Africanized bees are less defensive at night or very early in the morning. One Venezuelan beekeeper does all apiary work late in the evening, and another starts about 3 a.m.

8. Requeening and swarm prevention are best accomplished by moving all the brood with accompanying bees to a new unit. The old queen is left in the hive at the original location. The new queen is introduced to the new hive with standard introductory procedures; then the unit is placed at another location within the apiary. Since old bees fly back to the original hive, only young bees and brood remain in the new hive. The queen is usually accepted under these conditions.

9. Absconding can be prevented by providing the colonies with food when they have low food reserves, and when there is a dearth.

10. Many Venezuelan beekeepers import European queens and rear virgins from these queens. Generally these queens mate with Africanized drones and produce

predominantly hybrid workers. Such hybrids are easier to manage than pure Africanized bees.

11. Ferracane, M. S.[k] – A STUDY OF THE FEASIBILITY OF OBTAINING CONTROLLED NATURAL-MATINGS OF HONEY BEE QUEENS IN THE ADIRONDACK FOREST OF NEW YORK STATE – Experiments were conducted to determine the feasibility of obtaining controlled natural matings of honey bee queens in the Adirondack Forest of New York, using virgin queens and drones carrying the rare genetic color marker cordovan. This marker, resulting from the homozygous or hemizygous state of a single recessive allele, allowed the paternity of female progeny to be readily determined.

A preliminary study was first conducted in the study area, a small region of the central Adirondacks, to find areas lacking feral drones. This was accomplished by placing virgin queens in two to three mating nucs at 10 different locations several kilometers apart and observing if matings took place. Matings occurred at four of 10 locations indicating that not all parts of the Adirondack are suitable for controlled natural mating.

From the six suitable locations, one near the village of Newcomb was chosen as the site for the remainder of the study. An apiary was established there with 12 colonies headed by open-mated cordovan queens for the production of cordovan drones. A total of 21 mating nucs containing virgin cordovan queens were then brought to the apiary consecutively in three separate groups for between two to three weeks each. At the end of each period, the nucs were removed and the phenotypes of a sample ($N \geq 300$) of worker progeny from each queen were determined. In the first group of nucs, seven queens produced all cordovan offspring while two queens produced both cordovan offspring and a small number of wild-type offspring (329 cordovan: 16 noncordovan and 715 cordovan: 54 noncordovan). It was subsequently discovered that some of the colonies were harboring wild-type drones. (It is most probable that the drones were brought to the area in the large drone rearing colonies.) After removal of the drones, all 12 queens subsequently mated at the site produced exclusively cordovan offspring.

An additional four cordovan queens placed at three other locations from 12 to 16 kilometers from the site of the drone-rearing colonies also mated and produced exclusively cordovan offspring.

It was concluded that the Newcomb location was sufficiently free of feral drones to allow controlled natural matings of honey bee queens.

12. Fierro, M. M.,[l] A. Barraza,[l] D. L. Maki[f] and J. O. Moffett[l] – THE EFFECTS OF THE FIRST YEAR OF AFRICANIZATION ON HONEY BEE POPULATIONS IN CHIAPAS, MEXICO – The first Africanized honey bee *(Apis mellifera)* swarms began arriving in Chiapas, Mexico in September of 1986. In Chiapas, the Africanized process was first detected in feral colonies, and six months later apiaries began to be Africanized. Earlier the Africanization process was studied in Costa Rica at different elevations. A similar study is now underway in Mexico.

The topography of the Chiapas coast contains 2 different zones, a low and a high elevation zone. The lower zone is a coastal plain area with a maximum elevation of 100 m. above sea level, and an average annual mininum temperature of 17° C and maximum annual average of 35° C. An annual rainfall of 180 cm and average relative humidity of 75% characterizes this zone, which encompasses an area of 30 kms by 280 kms., bordered to the south by the Pacific Ocean and to the northeast by a mountain range (Sierra del Soconusco). This mountain range forms the SW border of the high zone, where average elevation is 1000-1500 m., the maximum elevation being 4000 m. at the Tacana volcano. The temperature in this zone is variable, with a minimum of 10-22° C and maximum of 24-26° C, and an average annual rainfall of (250 cm.).

Of the 1500 bait hives installed in 1986, 73 swarms were captured, of which 11 were identified as being Africanized. In 1987, there were 2500 bait hives in place, in which 531 swarms had been captured. Identified as being Africanized were 517 of these swarms (97%). Ninety-seven per cent of the swarms captured were in the low elevation zone, and 3% in the high zone between 200 and 400 m. In 1986, 870 samples from established apiaries were collected and all were determined to be of European stock. Through September 1987, 548 samples had been collected, and Africanization was present in 67 (17%) samples in the low elevation zone. In the high zone no positive samples for Africanization had been detected.

Accidents involving bees and humans have been at a minimum. Only three persons had been stung severely, one by European bees which required hospitalization. Moreover, a dog tied next to a swarm of Africanized bees and three chickens had been killed by these bees.

Table 1 – Swarms Captured January-August, 1987 Chiapas, Mexico

Zone	No. Swarms Captured	No. Africanized Swarms	No. European Swarms
Low (0-200 m).....	513 (97%)	510 (99%)	3 (1%)
High (200-400 m).....	18 (3%)	7 (39%)	11 (61%)
Total.....	531	517 (97%)	14 (3%)

Table 2 – Africanization of Established Apiaries in Chiapas, Mexico 1987

Zone	No. Colonies Sampled	No. Africanized Colonies	No. European Colonies
Low (0-400 m).....	394 (72%)	67 (17%)	327 (83%)
High (400-1500 m).....	154 (28%)	0	154 (100%)
Total.....	548	67 (12%)	481 (88%)

13. Harbo, J. R.[d] – USING MIXED SEMEN IN A BEE BREEDING PROGRAM – The procedure takes semen from many drones to create a homogeneous mixture of spermatozoa. A sample taken from the mixture may be genetically diverse, yet it is genetically equal to another sample from the mixture. Such a mixture would be useful in experimentation and germplasm storage as well as in selective breeding.

The procedure that I use involves 3 steps: (1) collecting semen into an insemination syringe, (2) injecting the semen into an equal volume of saline (1.25% NaCl and 0.3% dihydrostreptomycin sulfate) in a 3 ml conical centrifuge tube, and (3) stirring the mixture for 5 minutes with a glass rod (2 rounds per sec). The mixture is then recollected into a clean syringe and storage tubes and used to inseminate queens.

Four experiments used mutant markers to measure the degree of mixing (see table). Mutant marked queens were each inseminated with 1% of the mixture and at least 400 worker progeny from each queen were examined for the marker. When as little as 1.5% of the spermatozoa in a mixture carried the mutant mark (experiment 2), all 24 samples contained representatives of the mutant sperm. Moreover, the per cent mutant progeny produced by the queens in this and in the other experiments was only slightly greater than expected.

I think that this mixing technique can be used in a breeding program. Queens inseminated with mixed semen had a 9-month survival rate of 66% (n = 38), comparable to the 9-month survival rate of 65% (n = 37) for queens tested in previous years that had been instrumentally inseminated with unmixed and undiluted semen. The mixing technique does not produce perfect homogeneity, yet the variability caused by imperfect mixing seems insignificant when compared with other variables that exist in a stock testing

program.

Table – Results of queens inseminated with semen that had been diluted 1:1 with saline and stirred for 3-5 minutes.

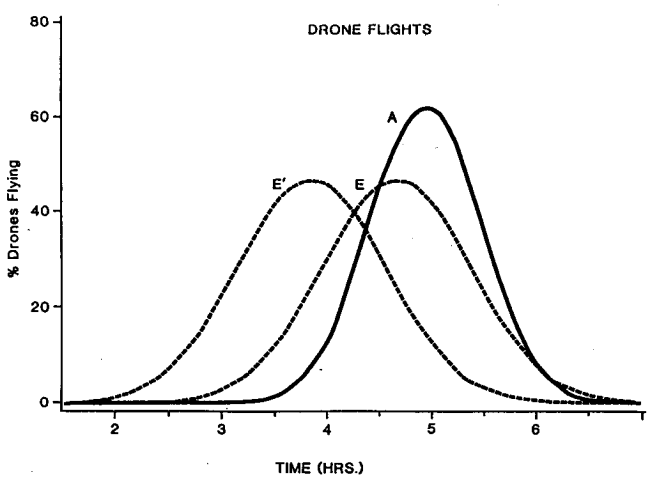
Exper. no.	No. of queens	Mean no. of workers counted per queen	Percent of marked workers per queen (range)	Expected % of marked workers from 95% of the queens†
1*.....	22	497	36.3-52.2	39.1-48.0
2	24	687	0.6-3.8	0.7-3.0
3	24	501	0.9-10.1	2.0-5.1
4	22	439	0.5-5.1	0.8-3.2

* The 4 experiments were done at different times and each mixture had a different proportion of marked spermatozoa. Experiment 1 had a high proportion (44%) of sperm with the eye marker chartreuse Benson (ch^B). Experiments 2 and 3 had very low frequencies of the body marker cordovan (cd), and experiment 4 had a low frequency of the eye marker snow (s).

† If the mixing were perfect and all the queens were producing exactly the same percentage of marked workers, the counting of only 500 workers per queen would produce this measurement error. This is the 95% confidence interval (5% of the counts are expected to fall outside this range).

14. Hellmich, R. L.[d] – FLIGHT-TIME DIFFERENCES BETWEEN AFRICANIZED AND EUROPEAN DRONES: IMPLICATIONS FOR CONTROLLING MATINGS – During experiments near Acarigua, Venezuela, European drones flew 20 ± 3 minutes earlier than Africanized drones, which confirms similar observations made by Taylor *et al.* (*J. Apic. Res.* in press.). These flight-time differences, however, were age dependent: sexually-immature drones (< 12 days) of the two types differed by 27 ± 3 minutes; and sexually-mature drones (≥ 12 days) of the two types differed by 11 ± 3 minutes. When the drones were 19 days or older, flight times of the two types were similar. Additionally, flight times of the European drones were 55% more variable than those of the Africanized drones (maximum-likelihood estimates: E = 0.31 ± 0.03, A = 0.20 ± 0.01). Flight-time distributions are shown in figure.

The author, however, concludes that differences of Africanized and European drone flight times are not an important factor in the process of Africanization because: 1) differences decrease during some weather conditions; 2) differences are reduced or eliminated when the bees interbreed, thus they are a temporary phenomenon; and 3) the superior reproductive behavior exhibited by the Africanized bees is considerably more important. Africanized bees swarm as much as 100-1000% more often than European bees (Winston *et al. Bee World* 64:12-21). This compares with the possibility of a 3% Africanized advantage due to flight-time difference (calculated from data in Taylor *et al., J. Apic. Res.*, in press).



Percentage of drones flying during an afternoon from Africanized colonies (A), European colonies (E), and European colonies which had been excluded (E'). Queens mated before 3:30 will mate predominantly, if not exclusively, with European drones.

A second experiment was conducted to alter flight times of European drones by preventing them from flying. This was accomplished by putting queen excluders at the entrances of the colonies. European drones that had been excluded for three days flew 36 minutes earlier than non-excluded European drones and 54 minutes earlier than non-excluded Africanized drones. These results suggest that a high percentage of desirable matings could be controlled by altering queen and drone flight times through management (figure).

15. DeGrandi-Hoffman, G.,[n] S. A. Roth,[n] G. M. Loper,[n] and E. H. Erickson, Jr.[n] – BEEPOP; A COMPUTER SIMULATION MODEL OF HONEY BEE COLONY POPULATION DYNAMICS – BEEPOP is a computer model that simulates honey bee (*Apis mellifera* L.) colony population dynamics. BEEPOP's construction is based upon two hypotheses. The first is that the number of eggs that a queen will lay per day is a function of: 1) the total number of eggs the queen has layed in her lifetime, 2) weather conditions (temperature and photoperiod), and 3) colony population size. The second hypothesis is that the number of eggs that are fertilized is dependent upon: 1) the amount of spermatozoa in the queen's spermatheca, 2) photoperiod, and 3) colony population size. All calculations in the model are updated daily throughout the simulation period. Estimates of the colony population size are subdivided into the number of house bees, foragers, and drones. Population estimates are reported to the user at the end of each brood cycle.

BEEPOP is an interactive model that permits users to change values for various parameters so the effects on colony population growth can be tested. The parameters include: 1) initial colony population size, 2) starting date of the simulation, 3) weather conditions, 4) number of drones mating with the queen, 5) number of eggs the queen can potentially lay per day, 6) number of days a bee can forage before expiring and 7) the number of brood cycles to be simulated.

Simulations where parameters were varied to test the effect on population growth, indicate that the number of eggs a queen can potentially lay per day has the greatest influence on population growth. The number of days a bee can forage before expiring also influences colony population size. Simulations were conducted with initial populations of 1500-7500 bees and starting dates of May, June, or July. The simulations were run under midwest and southwestern desert weather conditions with the purpose of simulating the growth of colonies started from swarms during those times of year. The largest populations resulted from colonies started in May, followed by June and July.

Simulations were run to determine the percentage of workers in the adult population that are of foraging age throughout the year. The simulations were run under midwestern weather conditions and indicated that in early spring prior to the occurrence of foraging weather the colony is composed primarily of older bees (*e.g.* about 97%). As foraging begins these older bees expire and are replaced by newly emerged adults. From late May to mid-July bees of foraging age comprised about 21-23% of the adult population. Bees of foraging age increased to 29-49% from August to September when colony brood rearing was declining. By the end of October, when foraging and brood rearing totally stopped, bees of foraging age comprised 99% of the adult population.

Population growth in the BEEPOP model assumes unlimited resources, and hence is not constrained by nectar or pollen availability. BEEPOP is constructed to be the core structure for which other models can be generated. A component that predicts rates of incoming resources, the effects on brood rearing, resource utilization and the production of surplus stores (honey) could be constructed. The development of models using BEEPOP as the core

component is the area where our future honey bee colony modeling efforts will lie.

16. Kerr, H. T.[i] and M. E. Buchanan[i] – ACOUSTICAL IDENTIFICATION OF HONEY BEES – Acoustical signals generated by flying honey bees were analyzed and showed characteristics that may be useful for field identification purposes. Acoustical data were recorded for European bees in Tennessee and for both European and Africanized bees in Venezuela. The data was subjected to standard noise analysis techniques which revealed specific characteristics that appear to be species specific. Specifically, sounds of flying European bees have dominant power in the 210 Hertz range; whereas, sound of flying Africanized bees have dominant power in the 270 Hertz range. This significant difference apparently results from wingbeat differences that may be attributable to the smaller wing size of the Africanized bees. A few data anomalies were reported that require further investigation and planned studies were described to determine effects of bee aging, load, fatigue, and hybridization. This acoustical approach to honey bee identification can readily be incorporated into a simple, inexpensive, field-portable, electronic device that would be very useful for beekeepers, regulators, and researchers. A prototype instrument was displayed that illuminates a green light in the presence of "flying European" sounds, and a red light in the presence of "flying Africanized" sounds. Patent protection has been initiated. Other beekeeping applications of acoustical technology are also being investigated.

17. Loper, G. M.,[n] J. L. Williams,[d] and O. R. Taylor, Jr.[r] – INSECTICIDAL TREATMENT OF FERAL HONEY BEE COLONIES BY TREATING DRONES AT DCA'S – Control over the mating potential of feral colonies may be one part of the solution to the Africanized honey bee (AHB) problem. The AHB produces prodigious numbers of drones, usually 6 to 8 weeks in advance of the spring season for European honey bees (EHB). Drones of the AHB are known to fly to the same drone congregation areas (DCA's) as the EHB drones.

Our initial ideas were tested on several feral colonies located in an area of SE Kansas. During several weeks in May and June, 1987 we used aerial drone traps, modified to allow drones to escape through the top where they contacted an insecticide (Ivermectin). The impact on both experimental colonies and several feral colonies was monitored. The number of drones killed and the concentration of insecticide residue were determined. The extent of drone mortality depended on the concentration of insecticide per drone and especially on the drone flight conditions both prior to and during the tests.

On one afternoon, treatment at two aerial traps about 300 meters from one feral colony resulted in the kill of approximately 3000 drones in the colony. We had previously estimated that the colony had 2600 flying drones. On other days, drone kills were not as spectacular, indicating to us that we need to find a method to get more insecticide on each drone in order to make the approach work.

18. Lozano, L. G.,[o] J. O. Moffett,[f] B. Campos,[o] and W. T. Wilson[f] – TRACHEAL MITE, *ACARAPIS WOODI*, INFESTATIONS IN HONEY BEES IN TAMAULIPAS, MEXICO – In a 1986 survey conducted in northeastern Mexico, 44% of the 6,200 honey bees examined were infested with trachael mites, *Acarapis woodi* Rennie. Mites were found in 80% of the 310 individual colony samples of 20 bees each. Samples were collected monthly from 10 colonies in each of 3 apiaries in the state of Tamaulipas. The bees were collected in the apiary and stored in 80% ethanol until they could be examined in the laboratory. Both prothoracic tracheae were dissected laterally under a stereoscopic microscope.

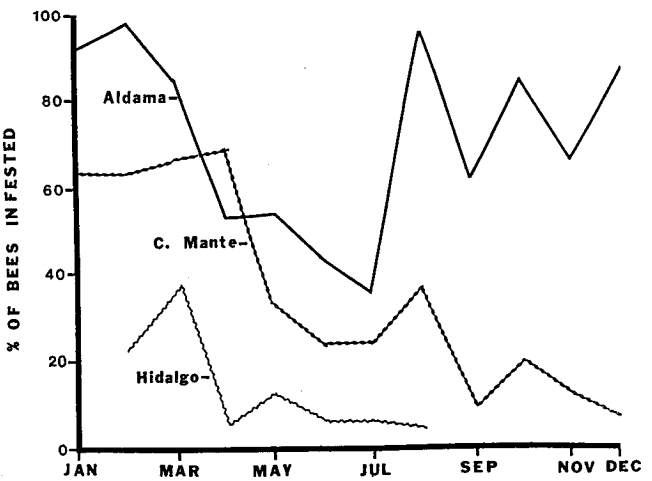
Infestation levels varied greatly among apiaries, months, and samples. Average monthly level of infestations ranged from a low of 2% of the bees in the Hidalgo Apiary in August to a high of 97% in February in the Aldama Apiary (see figure). The average level of infestation for the entire sampling period was 11% for the Hidalgo Apiary, 33% of the Ciudad Mante apiary, and 71% for the Aldama apiary. Mite populations tended to decline in the late spring and summer.

There was a significant correlation ($r = 0.91$, $p < 0.01$) between the percentage of bees infested in an apiary in a given month and the number of mites in each infested bee. Infested bees from apiaries with the four highest monthly samples had more than three times as many mites per infested bee as similar bees from apiaries with the four lowest infestations (44 mites per bee compared to 14 mites per bee). An overall average of 34.8 mites per infested bee were found in the 2,702 infested bees examined.

The proportion of mites in each life stage varied sharply by samples, months, and apiaries. Overall, 19% of the 92,392 mites counted were eggs, 37% were nymphs, and 44% were adults. Adult females consistently outnumbered males. The ratio of males to females was 1:2.43 or 29% to 71%.

Both right and left tracheae appeared equally susceptible to becoming infested, as mites were found in 2,144 right and 2,138 left tracheae. Both tracheae were infested in 58% of the bees parasitized with mites. There was a significant correlation ($R = 0.98$, $p < 0.01$) between the percentage of bees infested in individual colony samples and the percentage of infested bees with mites in both tracheae. However, mites infested the second tracheae only 76% as frequently as they should have if infestation of both tracheae were random.

Severe mite infestations frequently caused severe damage and even death of the affected colonies.



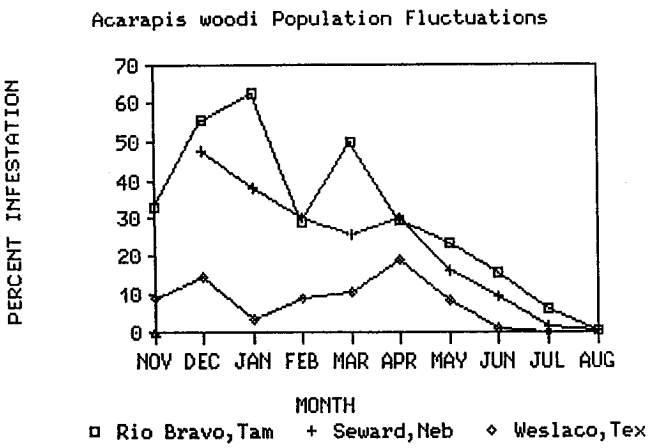
Variation in percentage of honey bees infested with tracheal mites in three widely separated locations in Tamaulipas, Mexico in 1986.

19. Maki, D. L.[f] W. T. Wilson,[f] W. L. Rubink,[f] and J. Vargas C.[y] – SEASONAL FLUCTUATIONS IN TRACHEAL MITE, *ACARAPIS WOODI*, POPULATIONS IN HONEY BEE COLONIES IN TEXAS, NEBRASKA AND MEXICO – The natural course of fluctuations in numbers of honey bees *(Apis mellifera)* infested with *Acarapis woodi* was monitored in the winter, spring, and summer of 1986-87. Samples of 100 adult worker bees from each colony were collected on a monthly basis and examined for *A. woodi* infestation in each of three apiaries, along with estimates of colony strength (bees and brood). The apiaries were located in Weslaco, Texas, Seward, Nebraska, and Rio Bravo, Tamps., Mexico.

Out of the initial 35 colonies, only 14 remained alive

after nine months. The initial 10 colonies in Weslaco were reduced to 5 colonies from bee mortality, in Nebraska 16 to 4, and in Rio Bravo 10 to 5. Average apiary infestation rates varied widely from near 0 to 63%. Individual colonies varied from 0 to 99%. The high colony loss in these infested bees was probably the result of stress caused by heavy parasitism from *A. woodi* alone or in conjunction with other stress factors.

Mite infestation rates tended to decrease from highs in December and January, to low levels during July and August. The levels of infested bees at Weslaco remained low during the entire year, while the levels were high at Rio Bravo during the winter even though the apiaries were only 25 miles apart. Thus, both apiaries were under the same climatic conditions, similar agricultural ecology and identical beekeeping management practices. However, the stocks of predominantly Italian bees were different. The Weslaco colonies were of Texas ancestry, while those at Rio Bravo originated in Mexico. We suspect that there is a genetic difference in mite susceptibility between the two stocks. The susceptibility of the Nebraska and Rio Bravo populations was similar even though climate and ecology were greatly different. In NE Mexico (Rio Bravo) the bees existed in a subtropical climate with hot summers and warm winters. Bees are able to fly throughout the year. Minor nectar and pollen sources are present during most the of the year, and brood rearing exists during every month of the year. Nebraska experiences hot summers with substantial honey production and brood rearing, while winters are very cold with little or no brood rearing over extended periods of bee confinement.



20. Mayer, D. F.[c] and C. A. Johansen[c] — EFFECTS OF METHOMYL ON HONEY BEES — Bee bioassay tests were conducted in the laboratory using a standard bioassay method (*Am. Bee J.* 127: 493-495). Results were as follows: (1) Methomyl 2% dust (1.0 lb. ai/acre) resulted in 98% mortality of bees with one-day residues, and methomyl 90 WP 3% mortality. (2) Methomyl 90 WP (0.5 lb. ai/acre) 8 hour residues were non-hazardous to bees; 1.0 rate 8 hour residues were low hazard. Elvanol 52-22, a water-soluble plastic at 0.25% and 0.5% provided no safening effect to bees. (3) Methomyl 25% WP and 90% SP (0.5 lb. ai/acre) did not differ in their hazard to bees. Eight hour residues of 90 SP (0.5 lb. ai/acre) were non-hazardous to bees; the 1.0 lb. ai/acre was moderately hazardous. (4) Methomyl 90 WP (0.5 lb. ai/acre) directly applied to bees gave 100% mortality. The 0.5 lb. ai/acre gave the following mortality sequence: leafcutting bees > alkali bees > honey bees > bumble bees. (5) Methomyl 1.8 LS (0.25, 0.5, and 1.0 lb. ai/acre) 8 hour residues were non-hazardous to bees. (6) Repeated applications of methomyl 1.8 LS (0.45 lb. ai/acre) at 5-day intervals caused increasing mortalities with successive treatments. Percent mortality for each application follow: 19, 28, 41, 63. (7) Adding Fundal 97 SP (0.24 lb. ai/acre), to methomyl 1.8 LS (0.225 lb. ai/acre) increased 2 hour residue mortality from 28% to 100%. (8) The sticker Adhere at 4 oz. per acre added to methomyl 90 WP at 0.9 lb. ai/acre reduced 8 hour residue mortalities from 39% to 16%. Adding the sticker Plyac at 4 oz. per acre did not reduce bee mortality. (9) Methomyl 90 WP 0.9 lb. ai/acre residues were held either at 18 C in the dark, 20 C in the dark, or 10 C - 35 C in the sunlight. Honey bees suffered more mortality from residues in the sunlight than with residues held in the dark.

In field tests, Methomyl was applied 4 times by plane at 0.45 lb. ai/acre to pollen shedding corn and data collected on dead bees, dead bees with tongues extended, number of bees collecting corn pollen and colony vigor during the test. Methomyl caused a low kill; 200 for one day after each application. Bees collecting corn pollen were reduced by 30%. There were no reductions in bee populations or brood in the test colonies.

Methomyl (0.9 lb. ai/acre) was applied by ground in the evening to a 0.25 acre of blooming red raspberries. As soon as bees began foraging raspberry blooms the next day, they showed behavior changes. They removed nectar, backed away and soon were shying away from treated blooms. Within a short time, most bees drifted along the rows to the check block. Foraging bees were counted during mid-afternoon of the first day and on days 2, 3, and 6. Methomyl showed a strong repellent action for 2 days and a lesser repellency the third day, increasing to normal activity by the 6th day. In a commercial planting, bees were repelled for 7 days and nearby colonies suffered a low kill.

Methomyl (0.9 lb. ai/acre) was applied at 8:30 p.m. on 16 April to a 0.08 acre plot of blooming blueberries. Weather was poor for bee flight until 18 April when enough bees foraged to collect data. The same kind of condition response was observed. Honey bees probed around the flowers, and then flew off to untreated portions of the field.

21. Moffett, J. O.[f] R. L. Cox,[f] M. Ellis,[g] and R. Rivera[f] — EFFECT OF WINTER TREATMENTS WITH MENTHOL ON POPULATIONS OF TRACHAEL MITES, *ACARAPIS WOODI*, OF HONEY BEES IN TAMAULIPAS, MEXICO AND NEBRASKA — Two studies were made to determine the effectiveness of menthol in controlling tracheal mites, *Acarapis woodi*, of honey bees during the cooler part of the year. The first study was conducted in two commercial apiaries near Soto La Marina, Tamaulipas, Mexico. Each treatment was applied to five colonies per apiary. On Nov. 20, 1986, varying amounts of menthol crystals in aluminum packets with screened tops were placed on the bottom board of each colony. These packets were replaced every 21 days so that the bees were exposed to menthol vapors continuously until the test was terminated on Feb. 2, 1987.

Each packet contained the following amount of menthol: 1) 0 grams (Check); 2) 10 gm.; 3) 25 gm.; and 4) 50 gm. The mite infestations increased during the test period as they normally do during winter. Thus, during this 11 week test, the percentage of infested bees in the control group increased 286% compared to a 261% increase for the 10 gm. treatment, a 151% increase in the 25 gm. treatment, and a 43% decrease in the colonies treated with packet containing 50 gm. of menthol. Thus, using the packets with 50 gm. of menthol reduced the mite population 78% compared to the untreated colonies.

Nebraska Study. On Feb. 10-11, 1987, 40 colonies with moderate infestations of mites were selected for this study from 140 single-story colonies at McCool Junction, NE. Colonies with heavy mite infestations were generally too weak to include in the study. The stronger colonies had low mite infestations. Twenty of the experimental colonies were moved into each of two apiaries. The colonies in each location were grouped into four treatments of five colonies each.

The menthol crystals were placed in petri dishes and melted in an oven at 50 degrees C. When all the crystals were liquefied, the open dishes were removed from the oven. The menthol soon solidified and was stored in a deep freeze until needed. Since the weather is cold in Nebraska in winter, and moderate warmth is needed to vaporize the menthol, the petri dishes were placed on the top bars of the frames directly above the broodnest.

Each dish contained 25 grams of menthol. The experiment was designed to determine the effect of various doses of menthol in reducing or eliminating the mites. Treatments were 0, 1, 2, or 3 petri dishes/colony.

The dishes were exchanged for new dishes of menthol after 5 weeks. After both 5 and 10 weeks, counts were made of all stages of live mites in freshly killed bees. Only moderate control was obtained the first five weeks, with mite reductions of -5%, 79%, and 45% respectively, as the petri dishes placed on the colonies increased from 1 to 3. Menthol was much more effective in controlling the mites during the second 5 weeks. By April 23, after 10 weeks of exposure to menthol, mite populations compared to the check colonies were reduced 72%, 91%, and 89% respectively, as the number of dishes applied increased from 1 to 3.

The amount of menthol that vaporized increased sharply during the second 5 weeks, undoubtedly due to increasing outdoor temperatures. The loss of menthol between the first and second 5 week periods rose from 1.8 to 5.6 gm./colony in treatment 2 (1 petri dish), from 3.8 to 7.6 gm. in the colonies which had 2 petri dishes, and from 6.0 to 10.6 gm. in colonies with 3 petri dishes.

The strength of the colonies also affected the amount of the menthol that vaporized. At the start of the second 5 weeks in the Nebraska study, 2 petri dishes were placed on the top bars of each of 10 strong two-story colonies with no known infestations of mites. During the next 5 weeks, menthol evaporated in these colonies at the rate of 0.22 gm./dish/day. Less than half as much evaporated per dish (0.10 gm./dish/day) in the weaker single-story experimental colonies during the same 5 week period.

The most effective menthol treatments gave ca. 80-90% control of trachael mites in the winter in both Mexico and Nebraska respectively, despite outdoor and within hive temperatures too low to give good vaporization of the menthol.

22. Pettis, J. S.,[f] W. T. Wilson,[f] F. A. Eischen,[h] and A. Suarez[p] — DISTRIBUTION OF *ACARAPIS WOODI* AMONG RUSTIC AND MODERN HONEY BEE HIVES IN NORTHEAST MEXICO — Two surveys were conducted (July 1984 and April 1985) to assess the distribution of *Acarapis woodi* in colonies of honey bees *(Apis mellifera)* located in northeastern Mexico. Both rustic and modern colonies were sampled according to United States Department of Agriculture guidelines (*i.e.* 10% of colonies in an apiary were selected with a minimum of 5 colonies sampled). The July 84 survey was carried out by Animal and Plant Health Inspection Service (APHIS) personnel under the direction of one of the authors (A.S.). The April 85 survey was a cooperative effort between Agricultural Research Service (ARS), Weslaco, TX (author W.T.W.), and University of Georgia (UGA), Athens, GA (authors J.S.P. and F.A.E.). Samples of 30-100 bees were collected from each hive and either 10, 20, 30, or 50 bees dissected to determine mite-infestation levels. In the July survey, bee samples were taken from 367 colonies in 63 apiaries while bees were collected from 200 colonies in 37 apiaries in April. These samples were representative of nearly 6,000 colonies.

The results in the table were based on positive or negative finding of mites in each sample. Utilization of "presence or absence" type data resulted from: (1) variation in sample size and, (2) seasonal fluctuations in infestation levels. Thus, comparisons of the infestation levels within the hives were not possible. However, the presence or absence of *A. woodi* still provides insight into the natural dispersion of the parasite.

The APHIS survey found infested colonies along the United States - Mexico border in the states of Tamaulipas, Coahuila, and Chihuahua. The ARS-UGA survey was conducted in Tamaulipas and Nuevo Leon and revealed positive samples in all but two apiary locations. These results illustrate that even with limited pressure from migratory beekeeping and queen shipments the tracheal mite has managed to spread throughout the bee population in northeast Mexico. This is similar to data from Brazil in which *Varroa jacobsoni* spread throughout colonies in the state of Sao Paulo, including isolated rustic hives (Goncalves *et al. Am. Bee J.* 122: 249-51).

Differences in infestation levels between the two surveys (17% vs. 61%) can be explained due to the expected drop in mite infestations during summer. Within the ARS-UGA survey a higher infestation level was present in rustic hives. This is consistent with findings by Eischen *et al.* (unpublished data) that requeening and other management techniques used in movable-frame hives helps to lower the infestation level.

The capturing of swarms and drifting of mite-infested drones is offered as a plausible explanation for the spread of *A. woodi* among rustic hives in Northern Mexico.

Table — Distribution of *Acarapis woodi* infestations in samples collected from rustic and modern honey bee hives in two surveys in northeast Mexico.

	APHIS SURVEY July 1984		ARS:UGA SURVEY April 1985	
	No. SAMPLED	% POSITIVE	No. SAMPLED	% POSITIVE
RUSTIC HIVES.....	282	13	23	87
MODERN HIVES ...	85	28	177	57
TOTAL.....	367	17	200	61

23. Ratnieks, F. L. W.[k] — GAMMA IRRADIATION IN THE CONTROL OF AMERICAN FOULBROOD AND STRESS DISEASES — Two experiments involving gamma irradiation were carried out concerning: 1) the efficacy of gamma irradiation in sterilizing hive equipment containing AFB scales; 2) whether irradiation of equipment obtained from hives which die during the winter before reuse is economically beneficial.

In experiment one, colonies were established in June 1987 using package bees (3 lbs.) in one deep or two shallow hive bodies. In apiary one 20 colonies were established using combs contaminated with American foulbrood (AFB) scales and eight control colonies were established using non-contaminated combs. All the combs had previously been irradiated with gamma irradiation (1 Mrad) using a commercial cobalt source. Monthly inspections of the brood chamber over the following three months revealed no AFB. In another apiary four control colonies were established using AFB-contaminated non-irradiated combs. After one month all four colonies had severe AFB infections.

In the second experiment 20 colonies were established in late April using 3 lb. packages in a single NY apiary belonging to a commercial beekeeper and using his equipment. Half were established on non-irradiated winter-kill equipment and half on irradiated (1.5 Mrad) winter-kill equipment. Colonies were given a second super of the same treatment after one month and finally a third super. All the third supers had been irradiated. The hives were managed by the beekeeper. Colony inspections and analysis of bees over the subsequent three months revealed low levels of nosema, sacbrood, and chalkbrook which were not significantly different between treatments. Colony weight gains were also not significantly different over the season April-June or April-September.

24. Rinderer, T. E.[d] – AFRICANIZED BEES: WHAT CONSTITUTES AFRICANIZATION – Standard, generally-agreed-upon principles of taxonomy guide the naming of groups as species. Chief among these principles is that species-specific characteristics can exist because members of different species do not freely produce fertile hybrids (Mayr, *Populations, Species and Evolution*, 1970).

The history of the nomenclature of subspecies of Western honey bees exemplifies 3 additional taxonomic principles. First, subspecies-specific characteristics have not been found in honey bees. Second, subspecies are distinguished as groups by the multivariate techniques of principal component analysis or discriminant analysis. Third, subspecies identifications are statistically based and hence probabilistic (Ruttner, pp. 23-52, In: Rinderer, *Bee Genetics and Breeding*, 1986).

The honey bees in the Americas constitute populations resulting from subspecies hybridization. Populations of Africanized bees from South America are morphometrically quite distinct from populations of *A.m. scutellata* in South Africa. In every respect the Africanized bees clearly show the genetical influence of their European parents (Buco *et al.*, *Apidologie* 18:217-222). Additionally, F_1 progeny of Africanized and European honey bees provide further evidence of the hybrid nature of Africanized bees. A comparison of Africanized bees from Argentina and from Venezuela shows that these two groups are morphometrically different and provides still more evidence of hybridization (Rinderer *et al.*, in preparation). It is clear that Africanized bees in the Americas constitute a "hybrid swarm" (King, *A Dictionary of Genetics*, 1968). That is, they are "a continuous series of morphometrically distinct hybrids resulting from hybridization."

Because of this hybridization, the identification of Africanized honey bees can only be through a multivariate statistical match of samples to a definitional population. Regardless of the biological characteristics measured (morphometrical, cuticular hydrocarbon, acoustical, DNA restriction-enzyme or isozyme), all identifications of Africanized honey bees will be statistically based and probabilistic.

25. Rivera, R.,[f] J. O. Moffett,[f] and R. L. Cox[f] – MENTHOL RESIDUES IN HONEY, BEESWAX, AND HONEY BEES – Menthol has given good control of the trachael mite, *Acarapis woodi*, under some conditions and is being widely used by some beekeepers. Therefore, analyses were conducted to find the levels of menthol (5-methyl-2-(1-methylethyl)cyclohexanol) in honey, bees, and wax from colonies being treated with menthol.

Residues were determined by gas chromatography. Average recoveries of spiked samples were 96.2% from honey, 93.5% from beeswax, and 94.6% from bees. The lower limit of detection was 0.10 ppm.

An average of 0.28 ppm menthol was found in honey from pre-treatment samples taken Oct. 14, 1986 at Weslaco, TX from 40 colonies. Menthol was detected in 12 of these colonies. After these samples were taken, the colonies were treated with 3 dosages of menthol in aluminum screen packets placed on the bottom board for 62 days. The menthol/packet was 0, 10, 25, or 50 gm., depending on the treatment. Fresh packets were given the colonies every 20-21 days.

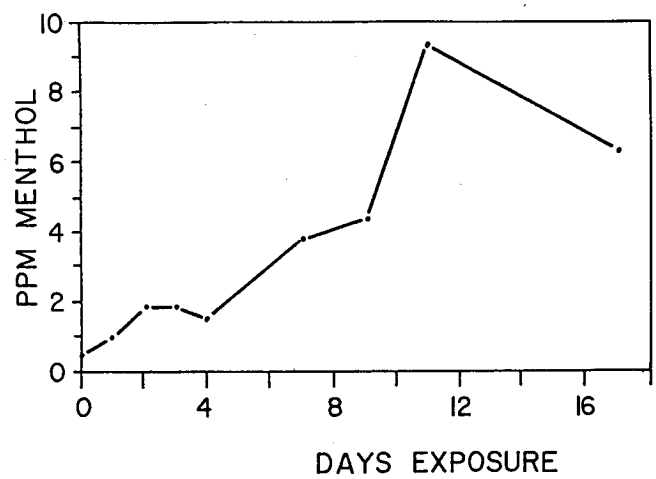
Menthol was found in some of the untreated colonies on each of the 3 sampling dates. Menthol residues increased in the honey as the dosage applied increased, and averaged ca. 2 ppm from colonies exposed to the 50 gm. packets of menthol.

Starting Nov. 20, 1986, 40 colonies near Soto La Marina, Mexico were given treatments identical to the Weslaco treatments. When the tests ended on Feb. 2, 1987 only one of the untreated colonies had detectable menthol residues (0.55 ppm). At the same time, honey from the 10 gm. treatment averaged 1.28 ppm menthol, compared to 3.28 ppm in the 25 gm. treatment, and 8.39 ppm in the 50 gm. treatment.

Colonies were divided and given new queens in Weslaco in early March preparatory to moving them to Nebraska. On April 8, 1 petri dish containing 25 gm. of resolidified menthol was placed on the top bars of 32 of 48 colonies for 42 days. By May 19, menthol residues from the untreated compared to the treated colonies were respectively 0.35 vs. 1.39 in honey, 2.10 vs. 24.37 for adult bees, and 9.48 vs. 77.62 for beeswax.

Starting Aug. 17, 1987, a 17-day study was conducted in Weslaco, to determine how menthol residues accumulated in honey. Two petri dishes each containing 25 gm. of menthol were placed on the top bars of 5 colonies. One colony was not treated. The daily maximum temperature ranged from 90-100° F. (32-38° C.) Menthol residues in capped honey in the 5 treated colonies were less than 0.10 ppm when the test started. Residues in the honey peaked at 9.37 ppm by the 11th day, but dropped to 6.30 on the 17th day (Figure). The menthol evaporated completely in some of the dishes before the end of the test, which probably accounts for the drop in the residue levels. Newly stored uncapped honey had 72 ppm menthol at the end of this test. During this 17-day test period, menthol residues in the untreated colonies remained below 0.10 ppm.

Honey from an untreated apiary near Mercedes, TX contained 1.18 ppm menthol, while honey from Georgia contained 0.12 ppm.



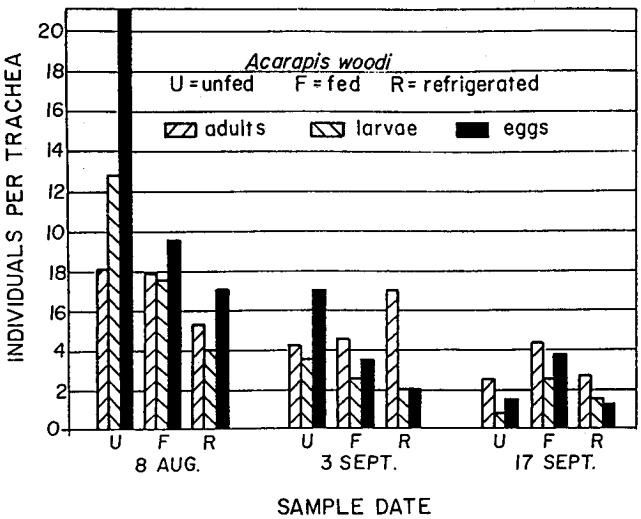
Residues in honey from colonies treated with 2 petri dishes, each with 25 gm. of menthol. The menthol was evaporated from some of the dishes before the end of the test, accounting for the drop in residues the last 6 days.

26. Rubink, W. L.,[f] D. L. Maki,[f] and W. T. Wilson[f] – EFFECT OF REFRIGERATION ON TRACHEAL MITE INFESTATIONS IN HONEY BEE COLONIES – Honey bee *(Apis mellifera)* colonies at Weslaco, Texas with known low-level tracheal mite *(Acarapis woodi)* infestations were subjected to refrigeration at 4°C to assess the role of forced host quiescence on tracheal mite infestation levels and population structure.

Fifteen colonies with infestation levels ranging from approximately 5 to 30% were separated into 3 equal groups on August 6. One group (R) was fed sugar syrup for 15 days and on August 21 was placed in cold storage. Two groups were maintained outdoors; one group (F) was fed sucrose syrup *ad libitum* and the other (U) was not. Mite infestation levels in each colony were monitored every 2 weeks in samples of 100 adult bees in 70% alcohol and 20 live bees. Infestation levels per bee, per colony, and per treatment were recorded, based on live dissections and KOH-digested thoracic sections. Life stage counts were made from the live

samples.

The results of the first 1.5 months suggest a slightly greater decrease in mite infestation levels per colony in the refrigerated colonies. Thus only slight variations in populations due to forced wintering are apparent. Population levels of mites per bee, measured as the proportion of the tracheal tubes of KOH-cleared thoracic sections filled with mites, remained relatively constant at mean treatment values of 44 to 59%. However, actual life stage counts, measured as the number of adults, eggs, or larvae per infested trachea of live bee samples showed a decline in individuals over the first 3 sampling periods (see figure). A slight increase in the adult/immature ratio is also apparent over the same time period. There is no apparent differential decrease due to treatment. It is expected that the altered age structure of the honey bee colonies in cold storage will eventually effect a differential increase in mite infestation levels. The experiment will be continued to examine this hypothesis.



Population levels of adults, larvae, and eggs of *Acarapis woodi* on 3 consecutive sampling dates in colonies refrigerated (R) or under natural conditions (U,F). Mean numbers of mites per infested trachea per colony are shown. Sample sizes varied from 10 to 35 trachea per treatment and sample date.

27. Sheppard, W. S.[u] and M. D. Huettel[u] – SUBSPECIFIC IDENTIFICATION OF HONEY BEES USING MITOCHONDRIAL DNA ANALYSIS – The honey bee genus *Apis* contains four well-recognized species and is entirely Old World in its natural distribution. However, one of the species, *A. mellifera*, was distributed throughout much of the world as an accompaniment to European colonization and today is widespread and quite familiar in North and South America and Australia – continents previously lacking *Apis*. Within the natural range of *A. mellifera*, a diverse assortment of geographic races or subspecies arose. Although the exact number is still a matter of some discussion, there appear to be around two dozen. Unlike a species, which can be generally defined by the notion of reproductive isolation, subspecies are able to interbreed (and often do). Therefore we have no genetically-defined distinctions and the identification of subspecies must rely on shared behavioral, morphological, biochemical or other genetic characteristics that identify a population as having a common genetic history. In addition, the uncertainty over the exact number of subspecies arises from the traditional problem of intraspecific classification of allopatric populations and the fact that, given the widespread natural range of the species, our sampling of more remote and less-traveled regions is less than adequate.

The use of protein electrophoresis in the discimination of closely related species or subspecies has been quite successful in the study of many organisms, including introduced populations. However, the lack of adequate polymorphism in the introduced honey bee populations of the New World has limited its utility. Another technique for investigating genetic relationships among organisms is the use of restriction endonucleases to analyze mitochondrial DNA. These enzymes recognize particular sequences of bases within DNA and cleave the DNA at these sites. With endonucleases, one can investigate variation in number and placement of recognition sites within the DNA itself. The rate of evolution, as measured by nucleotide substitution in the mitochondrial DNA appears to be several times faster than that of nuclear DNA, making it an ideal system to study closely related or recently diverged taxa, such as in the case of subspecies. We report research in progress in our laboratory on the use of mitochondrial DNA analysis to study variation within *A. mellifera*.

To date we have screened four subspecies of honey bees from the Old World, as well as Africanized bees from Venezuela and honey bees from the United States, using 15 restriction endonucleases. The restriction fragment patterns given by five of these enzymes vary among the subspecies and, therefore, show promise for subspecific discrimination and evolutionary study of the species. For four restriction enzymes (BCL-1, BGL-2, ECO-R1 and PST-1), the restriction fragment patterns generated by Africanized bees from Venezuela and *A. m. capensis* and *A. m. scutellata* from Africa were identical and distinct from bees from Beltsville, MD and Tampa, FL. These latter results, and the research of Dr. Deborah Smith at the U. of Michigan, support the possibility of using mtDNA analysis for the identification of Africanized bees. Consequently, we are currently testing some 20 other restriction enzymes on samples of bees from the Old and New World. However, the detection of mitochondrial DNA differences in honey bee subspecies is preliminary to the additional research necessary to satisfy the rigors of population genetics. Within the United States we know of the importation of eight subspecies, based on early agricultural reports and advertisements. We must therefore consider the diverse genetic background of current honey bee populations in the United States. Only after further screening of commercial and feral colonies from the U.S. and from areas of Mexico north of the current Africanized populations, would we feel confident in considering the differences we see in restriction fragments to be "markers" for Africanization.

28. Smith, R. K.[q] and B. K. Lavine[e] – COMPUTER MODELING OF HYDROCARBON DATA TOWARD DETECTION OF AFRICANIZATION IN HONEY BEES – During the last two years, a project at the Georgia Department of Agriculture has been under way to ascertain the utility of extracted hydrocarbons assay as a cost effective alternative to morphometric detection of Africanization in honey bees. A superficial analysis of the hydrocarbons leads to the conclusion that the European and African bees are much alike. However, an in-depth examination using capillary column gas chromatography has revealed that a wealth of information resides in the unsaturated fraction of the hydrocarbon extract (Smith, *Proc. Intern. Conf. Afr. Bees & Mites*. 1987, in press). This information consists of qualitative and quantitative data obtained from a single chromatographic assay of the extract. The raw data can be processed by a variety of computer based methods. Two models will be presented here, while another two are being presented simultaneous to this at the FACSS Conference in Detroit. It is worth mentioning that all the computer models give similar results.

A number of observations are reported based on the computer models:

1. The distinction between European and Africanized bees is straight forward. The only problems encountered are in the Florida feral population.

2. 97% of Africanized bees can be readily distinguished as hybrids from African bees.

3. The African bees examined divide into two branches which correlate to geographical source, *i.e.* Equatorial and Southern Africa. These branches are mirrored in the Africanized bee population and are to be expected as the original importations of African queens into Brazil were from Tanzania (Equatorial) and the Transvaal (Southern). This suggests the past inheritance of any sample of Africanized bees can be determined.

4. The parameters of the computer analysis can be made very restrictive. Once the parameters of a group of bees are defined, any deviations from the group are very easy to spot. Thus for monitoring queen and/or package producing operations, mutations or genetic intrusions can be quickly noted, isolated, and removed.

5. Work is under way to complete a data base for the identification of Africanization in queens and drones by hydrocarbons assay.

6. The material costs of the hydrocarbons assay are very reasonable at $1.50 per bee.

29. Sylvester, H. A.[d] – AFRICANIZED BEES, LACTOSE AND BIOTECHNOLOGY – The Honey-Bee Breeding, Genetics & Physiology Research Laboratory has a newly assigned research area of biotechnology. At present, the specific project is to use recombinant DNA technology to develop a system to transfer single genes into honey bees. The ultimate goal is to improve honey bees for agricultural uses, with a secondary goal of developing honey bees as a model system, particularly for other beneficial insects. Our more immediate goal is to develop new ways to control Africanized bees, either as part of a long-term genetic solution or as an interim control procedure.

A promising method would be to transfer a bacterial lactose digestion enzyme system into bees and then put out a network of sucrose and lactose syrup feeders. The lactose would be toxic only to untransformed bees. However, several questions must be answered first. 1) How toxic is lactose to colonies in the field? 2) What is the homology, if any, of bee and bacterial lactases? 3) Are Africanized bees equally susceptible to the toxic effects of lactose?

To begin answering this last question, Africanized and European bees, in groups of 30 bees, were placed in hoarding cages in an incubator in Venezuela. There were four cages per treatment per colony and five colonies per bee type. The treatments were: control (50% sucrose syrup), 5% lactose in 50% sucrose, 10% lactose in 50% sucrose and 15% lactose in 50% sucrose. Mortality (days until the 15th bee died in each cage) and syrup removal (mg/bee/day) were measured. The treatment effects of increasing mortality and decreasing syrup removal as the per cent lactose increased were highly significant for both effects. However, there were no significant effects of bee type or bee type by treatment interactions. Therefore, it can be concluded that both Africanized and European bees are similarly affected and react similarly to lactose when they are in hoarding cages in the laboratory.

30. Taylor, O.,[r] G. Rowell,[r] G. Otis,[s] S. Locke,[s] P. Kukuk,[s] M. Spivak,[r] M. Long,[r] J. Kaprowski,[r] G. Loper,[n] and W. Wolf[x] – FURTHER OBSERVATIONS ON MATING FLIGHTS BY DRONE HONEY BEES – Long-term goals of our research program have been to achieve maximum control of the types of drones mating with queens on mating flights to use the mating system to maximize the Europeanization of feral African bee populations. To achieve these ends we have attempted to define the dynamics of the mating process and to determine the factors which guide drones and queens to sites where matings occur. We have used aerial drone traps (Taylor, *J. Apic. Res.* 23:18-20) and age marked and individually numbered drones to determine flight times, distances flown, age specific behavior, and differences between races and among stocks. Radar (Loper, *et al. Apidologie* 18:163-172) has also been used to locate, track and define drone flight paths and drone congregation areas (DCA's). Similarities seen among flight paths and DCA's have led to the formulation and testing of a general theory of drone flight behavior and DCA's (Taylor, *et al.*, in prep.) Analysis of age and flight distances has shown that drone flight distances increase with age and that DCA's are composed of young drones from nearby colonies and older drones from more distant sources. The abundance of drones declines as a function of distance from the colony or apiary. These frequency distributions decline sharply with S.D.'s of 800-1500 m depending apparently on the age structure of the population being sampled (Taylor *et al. J. Apic. Res.*, in press; Taylor & Rowell, *Proc. Int. Conf. Afr. Bees & Mites*, in press; Rowell & Taylor, *Proc. Int. Conf. Afr. Bees & Mites*, in press; Locke & Taylor, unpublished data).

The regularity of drone abundance curves has led to attempts to create specific frequency distributions with cordovan and wildtype drone-sources. The results of these studies show that it is possible to obtain predetermined frequencies of drones of two or more types at specified distances by altering the distance between drone sources and the numbers of drones at each source (Taylor & Rowell, *Proc. Int. Conf. Afr. Bees & Mites*, in press; Rowell & Taylor, *Proc. Int. Conf. Afr. Bees & Mites*, in press; Taylor & Rowell, in prep.). In general, the results of these tests approximate the predictions of a neutral mating model and lead to the conclusion that manipulation of drone sources can be used to increase control of natural mating (Taylor *et al. J. Apic. Res.*, in press). Multiple recaptures of individually numbered drones have shown that there are cohorts of drones that repeatedly take flights in the same general compass direction (Taylor *et al*, in prep.). In these tests only 41.8% of all individuals at risk (992) were captured in 24 trap days at 10 DCA's distributed from 70 to 2523 m from the apiary. These results illustrate the difficulties of eliminating drone sources with the use of drone traps as suggested by Williams (*J. Econ. Ent.*, 80:532-536). Observations of exit flights of marked drones at colony entrances has revealed considerable variability within stocks in drone flight times and has shown that flight times are earlier in shorter photoperiods of spring and fall and later on days with higher temperatures (Rowell *et al. Apidologie* 17:137-158).

In Venezuela the difference between the peaks of European and African drone flight also showed seasonal variation being 15-30 min. in short photoperiods (December-January) and 35-45 min. in longer photoperiods (March-August) (Taylor *et al, J. Apic. Res*, in press). A selection program for early and late flying drone stocks that can be used to isolate mating of European queens from African drones and to improve the Europeanization of a feral African population shows that drone flight time responds to selection. In 1987 mean differences between several early and late colonies tested on the same day were as great as 32.6 min. and mean differences between all early and late colonies were 15.7 min. These results demonstrate the feasibility of developing selected lines for mating times to either reduce or increase the gene flow from one population to another (Rowell & Taylor, in prep.).

31. Waller, G. D.,[n] A. N. Mamood,[n] and G. DeGrandi-Hoffman[n] – RECENT RESEARCH IN POLLINATION OF MALE-STERILE COTTON – Cotton pollination, as practiced today and as described herein, involves the movement of pollen from anthers of the pollen parent, either upland *(Gossypium hirsutum)* or Pima *(G. barbadense)* to the stigma of a male-sterile flower of upland. The relatively large cotton pollen grains can be seen easily on the stigma. To obtain actual counts of pollen grains, stigmas of 1-day-old flowers have been placed in bottles with acetone and the

pollen removed by sonication. The correlation between pollen grains per stigma and seeds per boll has been determined, and indicates that *ca.* 100 pollen grains per stigma are needed to maximize seed set (Walker *et al.*, *Am Bee J.* 126:836).

Sonication, clarification, and concentration of samples are time consuming, therefore, we now make direct pollen counts on stigmas using a binocular dissecting microscope. Although the longitudinal grooves on the stigma sometimes close and obsure some pollen, counts comparing the sonication method with those of direct counting gave nearly identical results. The problem with the grooves closing intensifies as flowers age and make accurate counts especially difficult if it rains or if humidity is high. Thus, there is a need to collect the stigmas used for pollen counting as early as possible after pollination.

Earlier work showed that a simulated rain (water sprayed directly into the flower) reduced both boll set and seed production when done at 1400 hr. or earlier, but had little or no effect at 1600 hr. When stigmas were removed, however, even those that were intact until 1900 hr. and then removed resulted in a reduction in boll set and seed production. Thus, we examined stigmas removed from flowers that opened the previous day. When we collected these stigmas early in the morning and made the pollen counts immediately, our results compared favorably with those from the sonication method.

Several of our earlier hand-pollination and seed set tests indicated that Pima pollen might be inferior to upland pollen. On 5 dates during July and August 1987, we hand pollinated 50 male-sterile upland flowers each with Pima or upland pollen. We attempted to apply less than 100 grains per stigma. The mean number of pollen grains applied ranged from 43.8 to 107.2. Boll set percentages and seed numbers indicated that Pima pollen at times was slightly inferior to upland pollen, but at other times was not.

When cotton flowers were picked at hourly intervals to assess the diurnal rhythm of pollen deposition, a rapid increase in pollen loading between 0800 hr. and 1100 hr. occurred. However, a gradual decline in pollen grains per stigma occurred from 1100 hr. to 1600 hr. This decline might have been caused by pollen removal by the intense bee foraging activity (7 to 8 bees per 100 flowers) or possibly because increasing numbers of pollen grains were obscurred from view by the closing grooves as the flowers aged. Stigmas collected early on the day following anthesis and those collected the day of anthesis at 1600 hr. had similar amounts of pollen.

From these results we see that making pollen counts directly from stigmas was preferrable to using the sonication method if the stigmas had not been subjected to rain or excessive humidity. Further, whether hand pollinations were done using upland or Pima cotton, we saw little or no difference in boll set or seeds produced per boll. Thus, pollen compatibility in making the Pima by upland cross is adequate to encourage the continued effort toward development of the inter-specific hybrid.

32. Wilson, W. T.,[f] T. A. Woolley,[v] R. A. Nunamaker,[t] and W. L. Rubink[f] – AN ERYTHRAEID MITE EXTERNALLY PARASITIC ON HONEY BEES *(APIS MELLIFERA)* – A red-colored external parasite was observed on about 5% of adult-worker honey bees *(Apis mellifera)* in a colony in Guatemala in 1985. A sample of 10 bees was collected in alcohol by R. A. Bailey (U.S. Peace Corps) and sent to the USDA-ARS Honey Bee Research unit in Weslaco, Texas for examination. The parasite was identified as a larval mite. Some of the mites were attached by their mouthparts to the sclerotized cuticle of the head, thorax or legs of adult bees (Figure). One of the authors (TAW at Colorado State University) taxonomically place the mites in the family Erythraeidae. Two parasitized bees and several mites were sent to R. V. Southcott in South Australia. He identified the mites as *Leptus* sp.

Various species of Erythraeid mites are frequently known to parasitize Coleopterous and Orthopterous insects in the tropics, but they have been reported rarely from Hymenopterous hosts.

Since no adult mites were seen on the adult bees or in the bee brood, it is assumed that mite propagation occurs outside the hive. The larval mites may have gained initial contact with the host while the bees were foraging on floral parts or while standing on moist soil ingesting water. The infestation of the honey bees may have been a chance occurrence that happened while the bees and the mites temporarily occupied the same ecological niche. Cursory observations on the live bees within the hive did not reveal any obvious damage to the adult bees. However, six mites were attached to the legs of one worker bee; this seemingly would interfere with locomotion to some degree.

The mites remained attached firmly to the host bee by their mouthparts even following death from having been immersed in alcohol. Attached mites were heavily engorged while unattached mites were not. Engorgement undoubtedly indicates ingestion of bee hemolymph.

Although *Leptus* sp. and *Varroa jacobsoni* are both red- to brownish-colored ectoparasitic mites, there should be no difficulty in distinguishing between the two species under field conditions because of differences in body configuration and the number of legs. Adults of *Varroa* have 4 pairs of stout legs while the *Leptus* larvae have 3 pairs of spindly legs.

The larval erythraeid mite is attached by its mouthparts to the lateral surface of a thoracic sclerite on a worker honey bee. The red coloration of a live mite makes it readily visible on the adult bee.

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