Proceedings of the American Bee Research Conference

The 2007 American Bee Research Conference was held January 8-13 at the Sheraton Crescent Hotel in Phoenix, Arizona. The twenty-first American Bee Research Conference will be held in conjunction with the American Honey Producers Association and the American Beekeeping Federation at the DoubleTree Hotel in Sacramento, California on January 9-12, 2008. The following are abstracts from the 2007 Conference.

1. Baum, K. A.[a], Tchakerian, M.[b], Thoenes, S. C.[c] & R. N. Coulson[b] – AFRICANIZED HONEY BEES IN URBAN ENVIRONMENTS: A SPATIAL-TEMPORAL ANALYSIS – In the southwestern United States, including the greater Tucson metropolitan area, the feral honey bee population is predominantly Africanized. Feral colonies can be found in both natural and urban environments, and honey bee colonies will exploit urban sources of cavities, nectar, pollen and water. Africanized colonies will utilize smaller cavities than European colonies, expanding the range of suitable nest sites to include sites abundant in urban areas, such as flower pots, water meter boxes, tires, cement blocks, garbage cans and buildings. This broad range of nest sites increases the proximity of Africanized honey bees to humans, creating concerns over public health and safety. We obtained invoices with data on honey bee colony removals from 1994 to 2001 from BeeMasters Inc., a private company in Tucson, Arizona which specializes in the removal and control of Africanized honey bees. We used colony and swarm removal records to evaluate spatio-temporal patterns in the distribution of feral honey bees in the greater Tucson metropolitan area. We predicted that colony and swarm removals would show a strong spatio-temporal correlation with removed colonies and swarms located close together in space also occurring close together in time. We also conducted a cross-correlation analysis to identify any associations of colony and swarm removal numbers with rainfall and temperature across a range of lag times. Identifying patterns in the spatial and temporal distribution of Africanized honey bee colonies in urban areas is necessary to ascertain factors that contribute to Africanized honey bee use of urban habitats and to develop strategies to reduce contact between humans and honey bees in urban environments.

2. Bourgeois, L.[d], Sylvester, H. A.[d], Danka, R. G.[d] & T. E. Rinderer[d] – PRELIMINARY ASSESSMENT OF GENETIC DIVERSITY OF ITALIAN HONEY BEES IN THE U.S.A. AND ITALY - Declining numbers of breeder queens and the concomitant loss of genetic diversity potentially could result in inbreeding and increased susceptibility to pests and disease in honey bees. Genetic diversity of commercial Italian bee colonies in the United States and Italy was assessed using microsatellite genetic markers. We sampled worker bees from colonies of major queen breeders in both countries. To date, 13 U.S. and 14 Italian suppliers were represented. DNA was extracted from the thoraces of 4 bees per colony. Data from four microsatellite loci are presented here, and six additional loci are being analyzed.

Overall allelic diversity (mean number of alleles per locus) did not differ between the two groups ($P > 0.05$), although alleles were present that were unique to each group (Table). There were a total of 10 unique alleles among U.S. bees and 5 among bees from Italy. The U.S. "Italian" bees likely are an admixture of subspecies and thus have alleles that may not be present in the bees of Italy. Estimates of genetic differentiation using the population genetic parameter F_{ST} showed that bees from the USA and Italy differ ($P < 0.001$). Examination of the genetic structure within each group (USA and Italy), based on Cavalli-Sforza & Edwards genetic distance, indicated regional clustering for both groups. Samples from California queen breeders clustered together, as did all but one of the samples from the Bologna region of Italy. Higher resolution will be realized when more microsatellites and sample data are added.

Table - Allele counts and F_{ST} estimates for Italian bees collected from commercial queen breeders in the United States and Italy.

Locus	Repeat Unit	Country	Alleles	Unique Alleles	F_{ST}
L174	(GGA)10	USA	13	3	0.0393
		Italy	10	0	
L306	(GAA)20	USA	8	2	0.1597
		Italy	8	2	
L440	(TTTC)5	USA	3	0	0.2025
		Italy	6	3	
L504	(TC)12	USA	12	5	0.2625
		Italy	7	0	
Overall		USA	36		0.1633
		Italy	31		
Mean/locus		USA	9		
		Italy	7.75		

3. Calderone, N. W.[e] - A THREE-YEAR STUDY OF SCREEN BOTTOM BOARDS IN THE NORTHEAST - Screen bottom boards were evaluated to determine their usefulness in managing the parasitic honey bee mite *Varroa destructor*. In 2001, this device was evaluated on colonies in four apiaries, each with 16 colonies. Half of the colonies in each apiary were managed with standard bottom boards and half with screen bottom boards. Mite-to-bee ratios (~250 bee samples) and cluster sizes were obtained in October and November, respectively, after reducing colonies to two deep hive bodies. Colony weight gain was measured from June through September. The average weight gains for colonies with standard bottoms (69.07 ± 5.45 kg) and screen bottoms (63.34 ± 5.28 kg) were not significantly different ($F_{1,50} = 0.57$; $P < 0.45$). Apiary effects were significant ($F_{3,50} = 5.40$; $P < 0.0027$), but Treatment*Apiary effects ($F_{3,50} = 0.50$; $P < 0.69$) were not significant. The average October mite-to-bee ratios for colonies with

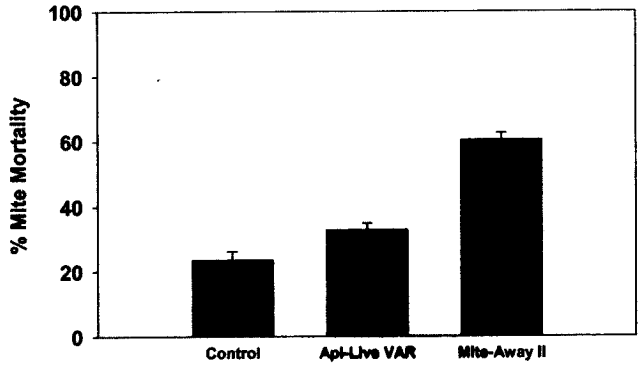
standard bottoms (0.09 ± 0.02) and screen bottoms (0.11 ± 0.02) were not significantly different ($F_{1,49} = 0.91$; $P < 0.35$). Apiary effects were significant ($F_{3,49} = 20.72$; $P < 0.0001$), but Treatment*Apiary effects ($F_{3,49} = 0.41$; $P < 0.75$) were not significant. The average November cluster sizes for colonies with standard bottoms (9.26 ± 0.55 combs of bees) and screen bottoms (8.46 ± 0.54 combs of bees) were not significantly different ($F_{1,49} = 1.10$; $P < 0.30$). Apiary effects were significant ($F_{3,49} = 13.54$; $P < 0.0001$), but Treatment*Apiary effects ($F_{3,49} = 0.26$; $P < 0.86$) were not significant.

Package bees were established in the spring of 2002 (n=24) and 2003 (n=32). Colonies were maintained in a single apiary each year, with half the colonies being managed with standard bottom boards and half with screen bottoms. The average weight gains for colonies with standard bottoms (49.04 ± 4.82 kg) and screen bottoms (55.76 ± 4.82 kg) were not significantly different ($F_{1,52} = 0.97$; $P < 0.33$). Year effects were significant ($F_{1,52} = 17.96$; $P < 0.0001$), but Treatment*Year effects ($F_{1,52} = 1.73$; $P < 0.19$) were not significant. The average October mite-to-bee ratios for colonies with standard bottoms (0.12 ± 0.02) and screen bottoms (0.12 ± 0.02) were not significantly different ($F_{1,52} = 0.00$; $P < 0.97$). Year effects were significant ($F_{1,52} = 29.56$; $P < 0.0001$), but Treatment*Year effects ($F_{1,52} = 0.12$; $P < 0.73$) were not significant. The average November cluster sizes for colonies with standard bottoms (7.21 ± 0.51 combs of bees) and screen bottoms (6.71 ± 0.50 combs of bees) were not significantly different ($F_{1,51} = 0.49$; $P < 0.49$). Year effects were significant ($F_{1,51} = 6.43$; $P < 0.01$), but Treatment*Year effects ($F_{1,51} = 0.04$; $P < 0.83$) were not significant. Screen bottom boards are not currently recommended for control of *V. destructor* in the northeast.

4. Calderone, N. W.[e] - EVALUATION OF API-LIFE VAR™ AND MITE-AWAY II™ IN THE NORTHEAST – Two miticides were evaluated as fall treatments for control of the parasitic honey bee mite *Varroa destructor* in upstate New York. Colonies were reduced to two deep hive bodies in early October. In each of five apiaries, six colonies were treated with Mite-Away II™ (formic acid), six with Api-Life VAR™ (thymol), and four served as controls. Mites were collected on sticky boards for four weeks; and then, treatments were removed and remaining mites were collected for six weeks on new sticky boards after applying four strips of both Apistan and CheckMite+ to each colony. Formic acid pads and thymol tablets were weighed every 8-12 days to determine the amount of product delivered.

Average mite mortality (Figure) was 32.66 ± 0.02% for colonies treated with Api-Life VAR and 60.22% ± 0.02% for those treated with Mite-Away II. Natural mite fall in the control colonies was 23.66% ± 0.03%. Treatment effects were significant ($F_{2,63} = 68.06$; $P < 0.0001$), and each mean was significantly different from the others (Tukey-Kramer; $P < 0.01$ each test). Apiary ($F_{4,63} = 1.06$; $P < 0.38$) and Treatment*Apiary ($F_{8,63} = 0.26$; $P < 0.98$) effects were not significant. The average temperature during the treatment period was 47.87 ± 1.29 °F, lower than label recommendations. Overall, only 53.60 ± 2.14% of the formic acid and 12.90% of the thymol product was delivered. Neither product provided adequate levels of control under conditions typically encountered during October in upstate New York.

Figure - Percent mite mortality with Mite-Away II and Api-Life VAR used as fall treatments in upstate New York.



5. de Guzman, L. I.[d] & A. M. Frake[d] - OBSERVATIONS ON THE LIFE HISTORY OF SMALL HIVE BEETLES – The life history of small hive beetles (SHB) kept in an incubator (34°C) and at room temperature (24-28°C) was compared. Six slides of eggs were obtained using the glass slide technique, and each slide was placed in a rearing container kept either in an incubator (n=3) or at room temperature (n=3). Egg incubation period was based on the time when 100% of the eggs hatched, which was observed to be 51 h (*ca.* 2 days) in the incubator and 71 h (*ca.* 3 days) at room temperature.

Larvae were reared individually within Eppendorf vials (1.5 ml) closed with moistened cotton wads to prevent desiccation. All vials were placed in partitioned trays (50 vials/tray), and trays were kept either in the incubator (n=2) or at room temperature (n=2). Each larva was fed one honey bee pupa. When larvae stopped feeding, moist potting soil (1.2 g) was placed in each vial to supply a medium for pupation.

Our results showed that the duration of each developmental stage of SHB was affected by temperature (Table). Developmental time was accelerated when larvae were exposed to 34°C, while exposure to 24-28°C slowed their development. Beetles kept in the incubator took *ca.* 23 days to develop from egg to adult, which was shorter than the duration of 32 days reported by Schmolke (1974, Certificate in Field Ecology Project Report, 178 pp.) at 30°C. A total developmental period of *ca.* 39 days was observed at room temperature, which was similar to that observed by Mürrle and Neumann (2004 *J. Apic. Res.* 40: 111-112) at 8-25°C, and about half the highest duration (81 days) reported by Lundie (1940 *Science Bulletin 220.* 30 pp.). Typically, each beetle spent >75% of its developmental time in the soil. Additionally, higher temperature resulted in larger and heavier adult beetles.

Our results suggest that temperature may significantly influence the abundance and impact of SHB on honey bee colonies. High temperature accelerates reproductive ability and developmental rate of SHB, resulting in an increased population that may damage honey bee colonies.

Table - Developmental time (days), weight and body size for *A. tumida* reared in an incubator and at room temperature.

Stages	Incubator (34°C)	Room Temp. (24-28°C)	*P*
Egg*	2.0	3.0	
First instar	1.0 ± 0[b]	2.6 ± 0.05[a]	0.0001
Second instar	1.0 ± 0.02[b]	1.8 ± 0.05[a]	0.0001
Third instar (Feeding)	2.9 ± 0.03[b]	3.1 ± 0.08[a]	0.025
Third instar (Non-feeding or wandering phase, mobile + immobile)	5.3 ± 0.06[b]	9.5 ± 0.08[a]	0.0001
Pupa	5.4 ± 0.06[b]	10.8 ± 0.07[a]	0.0001
Teneral adult to emergence from soil	5.1 ± 0.08[b]	8.5 ± 0.13[a]	0.0001
First instar larva to adult emergence from soil	20. 69 ± 0.08[b]	36.31 ± 0.10[a]	0.0001
Total development time (Egg* to adult emergence)	22.7	39.3	
Weight of newly emerged adult (mg)	12.23 ± 0.15[a]	10.75 ± 0.16[b]	0.0001
Length of newly emerged adult (mm)	6.15 ± 0.05[a]	5.37 ± 0.03[b]	0.0001
Width of newly emerged adult (mm)	3.46 ± 0.01[a]	3.36 ± 0.02[b]	0.0001

*** Estimates based on the time when 100% egg-hatching was attained.**

Means in each row followed by different letters are significantly different (P<0.05, Wilcoxon two-sample test).

6. Delaplane, K. S.[f], Ellis, J. D.[g] & J. A. Berry[h] - PROFITABILITY OF A VARROA IPM SYSTEM – Our lab has been engaged for over ten years in the development of a comprehensive integrated control program for varroa mites. Phase one resulted in an economic threshold (ET) for the Southeast (1999 *Apidologie* 30: 383-395). Phase two was a demonstration that bottom screens and genetically mite-resistant queens reduce colony mite levels and delay economic threshold (2005 *J. Apic. Res.* 44(4): 157-162). The third and final phase, summarized here, examines the economic feasibility of IPM. Six beekeeper collaborators, ranging from sideliner to commercial, each contributed 21-30 colonies in one apiary. Colonies were each assigned one of three treatments: (1) chemical (Feb and Aug treatments with acute miticide), (2) IPM (Russian queen plus screen hive floor), or (3) experimental check (no miticide, non-selected queen, conventional hive floor). IPM performed better than chemical treatment as measured by honey production, colony mortality, and queen supersedure (Table). IPM values for mite levels and percentage of colonies reaching ET were lower than the check group and comparable to the chemical group. Time inputs were highest for IPM colonies; a difference explained by the time spent counting mites on screens. When this factor was removed, time spent working IPM colonies was lower than chemical colonies. This study shows that IPM does not sacrifice profitability. Improved or abbreviated sampling will eliminate the only liability remaining to IPM.

7. Delaplane, K. S.[f] & A. M. Ellis[g] - VARROA AND SHB IN CONTEXT OF PLANT POLLINATION – If hive invaders like *Varroa destructor* and *Aethina tumida* impact crop pollination negatively, it may happen at two levels: (1) the bee population level where exotic invaders induce colony mortality or (2) the colony level where compromised foragers pollinate less efficiently. This preliminary report summarizes two years of field data acquired by manipulating bee colonies to achieve various levels of varroa mites or small hive beetles (SHB), then tenting them with one of two model plants in flower: canola and rabbiteye blueberry. Pod-set in canola was unaffected by different levels of honey bee nest invaders. Instead, a pod-set benefit was indicated by the presence of bees, regardless of the degree to which their colonies were infested. The fact that pod-set was lowest in the no-bee tent supports the belief that flower shaking, whether by wind or insects, is important to pollinate this crop (1988 *Apidologie* 19: 51-72). In blueberry, bee flower visitation rate was unaffected by different levels of honey bee nest invaders. Fruit-set, like pod-set in canola, depended more on the simple presence of bees rather than the degree to which their colonies were compromised by pests. Visitation and fruit-set were higher in plants tented with bees than in open plots, an artifact noted regularly in this system. Under our conditions we have failed to identify negative pollination impacts of nest invaders at the colony level.

Table - Feasibility of integrated pest management (IPM) to control varroa mites as compared to regimented use of a miticide (Chem). Experimental controls (Check) were not treated with miticides, had standard bottom boards, and had bees derived from unselected queens.

Treatment	Avg. mite counts	% of colonies reaching ET	2006 honey production (lb)	% of colonies dead after 2 yr	Queen supersedure rate	Time (h) spent working colonies	Time (h) working colonies, minus counting screens
Chem	13.1	69	1104	61	46	33.5	33.5
IPM	17.9	74	2053	39	39	40.4	31.5
Check	21.3	94	660	72	55	30.4	30.4

Table – Comparison of different levels of two colony pests on the pollination success for canola and blueberry in a controlled environment. The presence of varroa mites or small hive beetles did not negatively impact the pollination of either plant. However, the presence of bees significantly increased the pollination for both plants.

Canola		Blueberry		
Tent treatment	Pod-set (pods per flower), 2005	Tent treatment	Bee blueberry flower visits / 2 minutes, 2006	Blueberry fruit-set, 2006
Open	50.6a	Open	2.6b	36b
High Varroa	58.2a	Varroa	38.5a	55a
Low Varroa	53.5a	SHB	34.6a	58a
High SHB	62.6a	No pests	38.1a	44ab
Low SHB	55.6a	No bees	[redacted]	18c
No pests	62.5a	[redacted]		
No bees	36.1b			

8. Eischen, F. A.[i], Graham, R. H.[i], Rivera, R.[i] & J. Traynor[i] - ALMOND POLLEN COLLECTION BY US OVERWINTERED COLONIES AND AUSTRALIAN PACKAGE COLONIES – A possible honey bee colony shortage for almond pollination and high pollination fees ($130-150 per colony) kindled interest in importing packages of adult bees from Australia. During the 2006 season 30,000+ packages were imported. We compared the performance of Australian (AUS) package colonies with overwintered US colonies.

Pollen collected by US 8-frame colonies was about 2.5 times that of AUS 4-lb package colonies established in late January 2006. Pollen collection by US 6-frame colonies was similar to the AUS 4-lb colonies and both of these were significantly higher than the AUS 3-lb colonies established in late January 2006. All groups collected significantly more pollen than the AUS 4-lb colonies established in mid-December 2005.

The weight of pollen collected per frame of bees (foraging rate) by AUS 4-lb colonies was about 65% as US 8-frame colonies. Over the 20-day collection period, AUS 4-lb colonies lost strength, but their pollen collection did not decline proportionately. Calculated on ending bee populations, pollen collection by Australian colonies was about 112% of US colonies. We assume that this was, in part, caused by an increased effort to meet the needs of an enlarged broodnest and an ageing adult population more likely to forage. However, based solely on pollen foraging behavior, an Australian 4-lb package colony was worth about half that of a standard overwintered US colony for pollinating almonds.

Almonds were pollinated throughout the day, but pollinator exclusion data indicates that a slightly higher percentage was set 10.30 – 13.00hrs. An analysis of foraging flights by test colonies and nut set data indicate that a disproportionate number were pollinated late in the afternoon. We speculate that diminished pollen per blossom caused by previous foraging caused bees to visit additional blossoms and this caused a higher rate of inter-cultivar visitation and nut set.

9. Eischen, F. A.[i], Graham, R. H.[i] & R. Rivera[i] - DEVELOPING HIVASTAN® (FENPYROXIMATE) FOR THE CONTROL OF *VARROA DESTRUCTOR* – The efficacy of an experimental 0.3% fenpyroximate preparation (Hivastan®, Central Life Sciences-formerly Wellmark International) was tested against *Varroa destructor* known to be resistant to fluvalinate and coumaphos during 2004-2006. Fenpyroximate is a pyrazole acaricide and is lipid soluble. Its route of entry to the parasite is through contact. Using laboratory test cages, fenpyroximate demonstrated a LD_{50} of about 118 µg/bee.

A series of preliminary field trials found that the most effective presentation was a grease patty composed of hydrogenated vegetable oil, powdered sugar, irradiated honey and 0.2 – 0.3% fenpyroximate. The honey was found useful in getting bees to interact with the patty to insure contact. The honey was irradiated to insure against viable American foulbrood spores and other disease organisms. Patties weighing 227g were applied above waxed paper to the top bars of brood frames. Evaluations of colony strength, broodnest size and mite load were assessed at the beginning and end of trials.

Several large field trials (20-30 colonies per treatment group) have been conducted in central and south Texas, as well as the central valley of California. Efficacy (*ca.* 95%) was equal to or better than Apiguard® [Vita (Europe) Limited]. Efficacy remained high under a wide range of temperatures (5 – 40°C) and various climatic conditions. High temperatures caused patties to be a little more difficult to handle, and we routinely held them in chilled ice chests for convenience.

Todd dead bee trap studies found that adult worker bee mortality was elevated above controls during the first 24hrs of treatment. Thereafter, no difference in adult mortality was observed. We do not know the cause for this. It is possible that many of dead bees in our traps had been previously weakened by varroa (many had twisted wings). We doubt that beekeepers will observe any significant colony impairment if patty material is removed after 42 days of treatment.

The Weslaco laboratory is committed to finding alternative control products for the parasitic mite *Varroa destructor*. Our goal is to assist in bringing to market an array of products for its control so that U.S. beekeepers can conduct an effective rotational scheme and reduce the impact of acaricide resistance. Our evidence shows that Hivastan® provides effective control.

10. Ferrari, T. E.[k] & A. B. Cobb[k] - ONE COLONY WITH SUPPLEMENTAL POLLINATION IS BETTER THAN TWO WITHOUT EXTRA POLLEN: CASE HISTORIES – Consistent improvement in almond production for flowers exposed to enpollinated honey bees is evidence foragers are inherently inefficient at cross pollination. Enpollination is the application of compatible pollen directly onto bees using a dispenser located at the hive entrance — a practice termed ***supplemental pollination.***

Thirteen orchards were evaluated in which new pollen application strategies were used during the 2002 to 2006 bloom periods. Varieties exposed to enpollinated bees ranged from 12 to 150 acres; orchards contained 2 to 4 different varieties; and ages ranged from 8 to 23 years. Pollen doses ranged from 100 to 200 million *Viable Pollens /acre,* and pollen was 100% compatible with targeted flower pistils. Production histories were provided by growers and ranged from 3-9 years. In 7 cases, only 1 colony/acre was used when pollen was applied to a targeted variety; additional hives were introduced after enpollination was complete, as 2 to 3 colonies/acre is customary.

Historical yield ratios between 2 varieties when no pollen was applied (before) were compared with ratios for years when pollen was applied (after) to a treated variety (non-treated varieties acted as controls since they were either not in bloom or flowers were no longer receptive when pollen was dispersed). Changes in "before" and "after" ratios were used to calculate yields due to natural vs. supplemental pollination. A 1-tailed Z-score was the test statistic used to analyze probabilities that a yield ratio between a treated and non-treated cultivar was different than the historical average (no treatments).

All 13 orchards exposed to enpollinated foragers had increased yield ratios and, consequently, almond production (Table). Statistically significant ($P < 0.05$) changes in ratios were achieved in 9 cases. Supplemental pollination caused an average of 525 lbs/acre ***EXTRA*** for 7 cases when 1 hive/acre was used and 988 lbs/acre extra after pollen was applied to the stronger of 2 colonies when 2 hives/acre were used.

Evidence indicates it is feasible to improve almond yields while reducing colony numbers, which can mitigate demand and annual rental costs.

Table - Almond production for varieties exposed to enpollinated honey bees

(Supplemental Pollination = SP).

Case	Variety	Yield without SP	Production due to SP	SP as percent of total
		lbs/ac	lbs/ac	%
1.	Sonora	1352	1473	52.1 **
2.	Butte	1120	1125	50.1 **
3.	Sonora	1351	1154	46.1 *
4.	Nonpareil	946	599	38.7 **
5.	Nonpareil	2227	1134	33.7 **
6.	Butte+Padre	1964	773	28.2 *
7.	Sonora *	2042	779	27.6 **
8.	Nonpareil	2237	826	26.9 **
9.	Sonora	1748	557	24.2 *
10.	Sonora	1876	492	20.8 *
11.	Sonora	1987	391	16.4 *
12.	Sonora	1939	176	8.3 *
13.	Nonpareil	1625	133	7.6 *

* Indicates 1 hive/ac, ** 2 hives/ac.