Project No. 00 -RP-o0 - Honey Bee Management, Genetics, and Breeding

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Objectives:

1. Develop management methods for the commercial beekeeping industry to maintain and produce commercial honey bees of good genetic stock that are resistant to diseases, free of objectionable Africanized honey bee genetic material, and are of high commercial value for pollination.

2. Selectively breed and maintain strains of bees that are more effective pollinating units.

3. Study the effects of the genome and the colony environment on the foraging behavior of honey bees in order to manipulate both and achieve greater pollination activity in colonies.

4. Conduct DNA surveys of feral honey bee populations to determine the extent of the spread of Africanized honey bees in California.

Objective 1 and 3: Synthetic Brood Pheromone

We have been developing a synthetic pheromone for the stimulation of pollen foraging. Our investigations began by demonstrating that hexane extracted substances from the cuticle of larvae stimulate pollen foraging. In 1999 we demonstrated that one syntheic blend increased the number of pollen foragers more than another. However, this blend did not significantly increase pollen foraging in a large-scale experiment conducted with colonies pollinating almonds.

We recognized that the amount of pheromone the colonies were receiving might not have been sufficient to stimulate pollen foraging. Therefore, in

February-March 2000 we tested the effect of increasing doses of synthetic brood pheromone on the ratio of pollen to non-pollen foragers on honey bee colonies in an almond orchard. A significant increase in the ratio indicates that the number of pollen foragers has been increased. Preliminary small trials performed in flight cages suggeted that a dose of 3:1 (pheromone : adult bee) significantly increased the ratio of pollen to non-pollen foragers.

We treated seven colonies with 3:1 brood pheromone larval equivalents to adult honey bees presented on glass plates placed in the brood nest area of the colonies. Another seven colonies were controls, given blank solvent treated glass plates. One and two hours after treatment the number of pollen and non-pollen foragers entering each colony was counted for a 5-minute interval. The pollen to non-pollen forager ratio was significantly greater in the pheromone treated colonies one hour after the treatments were applied (Table 1; Fig.1). Two hours after application there was no treatment difference in the ratios of foragers (Table 1; Fig. 1). When the glass plates were removed from the colonies approximately 3 hours after application there was no visible residue of pheromone remaining.

Table 1. Contingency table analysis results of foraging responses to increasing doses of BP.

Experiment	Hour after treatment	G value	Prob.
3:1 BP vs Control	1	47.8	****
	2	0.7	ns

ns $p>0.05$, **** $p<0.0001$

In a separate experiment, 12 colonies were selected to alternately receive a pulse treatment of a 10:1 ratio of synthetic pheromone to adult bees and a control treatment. At 0930 h (Pulse I) six colonies received a glass plate carrying the synthetic pheromone treatment and it's nearest neighbor received a control plate. The application of the treatments and inter-colony interval were timed so that by the time the last colony received it's treatment 1 hour elapsed. One hour after a colony received its treatment, a 5-minute entrance count was performed and the treatment was removed. A second entrance count was performed 1 hour after the treatment was removed. Then those colonies that previously received pheromone were treated with a control plate (solvent only) and those that previously received a control plate now received pheromone (Pulse II at about 1300 h). The protocol for timing and counting were the same as described above.

There were significant treatment differences in the ratio of pollen to non-pollen foragers for colonies receiving the pulse treatments one hour after application (Table 2, Fig. 2). One hour after the treatments were removed the pheromone treated colonies had entrance counts that were not significantly different from the controls for both pulses periods (Table 2; Fig. 2). These results are direct evidence that the synthetic pheromone acts as a releaser of pollen foraging that is amenable to a high degree of user control.

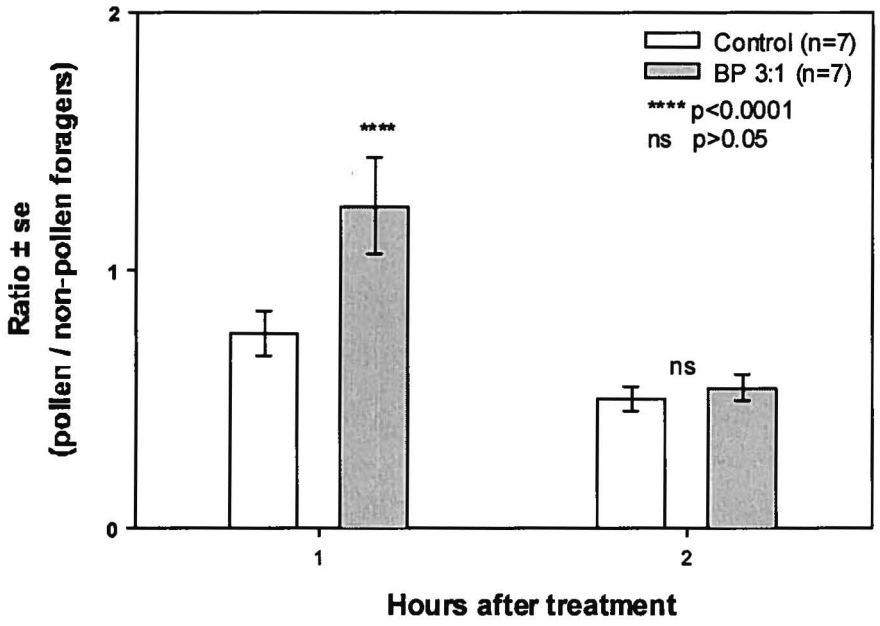

Figure 1. Ratio of pollen/nonpollen foragers 1 and 2 hours after treatment with brood pheromone.

Table 2. Contingency table analysis results to foraging responses to pulse treatments of brood pheromone.

Pulse	Time	G value	Prob.
I	1 hour after treatment	186.4	****
	1 hour after BP removed	0.5	ns

II	1 hour after treatment	525.6	****
	1 hour after BP removed	3.8	ns

ns $p>0.05$, **** $p<0.0001$

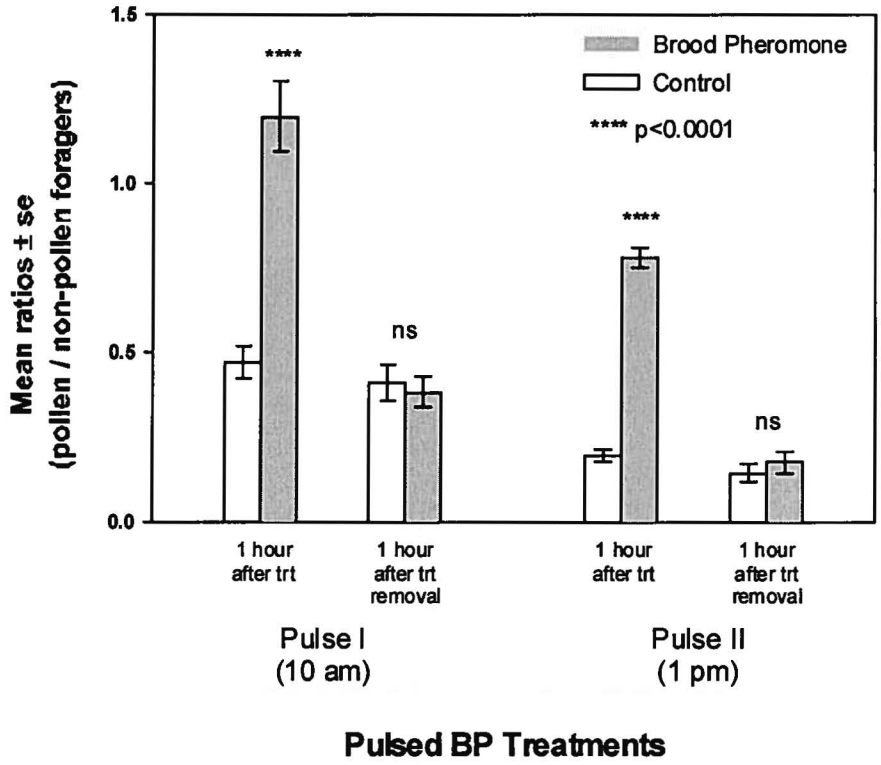

Figure 2. Ratio of pollen/nonpollen foragers in pulsed treatment experiment.

We currently have a patent pending on this synthetic pheromone and are trying to find cooperators to help develop a better mechanism for delivering the pheromone to colonies. We hope to eventually make this product available to increase pollen foraging activity in almond orchards.

Objective 1: Selection for Resistance to Varroa mites

Varroa mites feed upon adult and larval honey bees causing severe damage to workers and eventually the death of the colony. They are the number one problem in commercial beekeeping today and are the number one reason for

the decline in numbers of commercial colonies. Currently, Varroa is controlled chemically by application of fluvalinate, a chemical designed to kill mites but not bees. However, it has been recently reported that Varroa are becoming resistant to fluvalinate, a potential disaster for the bee industry.

Two years ago we initiated a breeding program with the USDA Honey Bee Laboratory in Tucson, Arizona to test the efficacy of selecting for physiological resistance to Varroa. After two generations of selection we found no detectable change in Varroa susceptibility. We concluded that it is not feasible to select for this type of resistance.

Objective 4: The Distribution of Africanized Honey Bees in California

Africanized honey bees were first detected in California in October, 1994. Since then, we, along with the California Department of Food and Agriculture, have been monitoring their spread and increase in population using a DNA diagnostic technique that we developed. The range was mostly limited to the Imperial Valley until the spring of 1998 when the range and population underwent a tremendous increase extending throughout most of the south-eastern desert regions of California and into Los Angeles County. Last year we reported that Africanized honey bees had increased their range into the north-eastern corner of Kern County. This year we sampled from Modesto to Bakersfield and did not detect any AHB range expansion.