

PROJECT TITLE: Developing an artificial diet for the honey bee

Apis mellifera

Project Number- 02-GW-01

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Objectives:

- 1. Develop a liquid artificial diet for honey bees that will stimulate colonies to rear brood at rates comparable to colonies fed on natural pollen and be compatible as a carrier for the slow release essential oils.**
- 2. Compare brood survivorship in colonies fed on artificial diets to those fed on natural pollen.**
- 3. Monitor longevity and viability of adult bees reared from larvae fed the artificial diets and compare these data to bees reared on natural pollen.**
- 4. Determine if workers and foragers raised on artificial diets can rear consecutive cycles of viable brood.**

Objective 1: Develop an artificial diet for honey bees that is as attractive and as productive as natural pollen.

Starting from a base diet suggested by Dr. Allen Cohen (USDA-ARS Mississippi), a series of preference tests were set up to systematically test mixtures of components for palatability. The first diet developed was a high protein-carbohydrate diet that meets all honey bee nutritional requirements as reported in the literature. The current formulation has been highly successful in colony tests here in Tucson as well as five locations around the country where collaborators tested the product on commercial colonies. When fed through in-hive-feeders, the diet was observed to be stored near the brood not in the surplus honey section of the colony. With the use of fluorescent dyes, the diet was found in all colony members and was a significant component in worker larvae food.

Objective 2: Determine brood survivorship during honey bee developmental stages.

To restrict open foraging, twelve, five frame nucleus colonies (nucs) were placed in a 27 cubic meter flight cage. Four of the nucs were fed the new diet, four were fed a mixture of natural pollen and sugar in patty form and the remaining four were fed sugar syrup alone. A separate set of four control nucs were established outside the cage to act as an open forage control. When square inches of sealed brood in these colonies was quantified, no significant differences were observed. Diet fed colonies produced as much brood as did pollen fed colonies. The colonies outside the cage did produce significantly more brood than did the caged bees, but this difference is likely due to the stress of living in a cage. Feeding trials this winter should resolve these questions.

Objective 3: Monitor longevity and viability of adult bees reared from larvae fed the artificial diets and compare these data to bees reared on natural pollen.

Viability study: After 21 days on these diets, queens were caged on frames in each nuc to establish uniform patterns of brood of equal age. Eggs, larvae, pupae and emerging adults were tracked by noting newly vacant cells this was done to determine if the diets supported all stages of development. No significant difference was observed between the diet, pollen control and the open forage treatments indicating that the diet supported all developmental stages.

Longevity Study: One hundred emerging bees each from the control and diet treatments in the viability study (Objective 2), were marked and introduced to an open foraging nucleus colony. Twice weekly their numbers were counted to determine if any differences in longevity existed between diet raised and control bees. Results indicated that there was no difference in longevity between diet fed and pollen fed bees. To further test the diets ability to support colony development, an in-vitro longevity study is underway at the laboratory. Caged bees will be fed artificial diet and pollen based diet. Results of this study should help determine the nutritional value of the liquid diet.

Objective 4: Determine if workers and foragers raised on artificial diets can rear consecutive cycles of viable brood.

Currently, we are undertaking a field trial of the diet in eight full size colonies outfitted with pollen traps to limit the amount of outside protein entering the colonies. Early results indicate no difference between the treatments and the controls. The real test of the diet will come this winter when outside pollen is unavailable. In other field trials, we plan to provide liquid diet to commercial breeders and pollinators on the West and East coasts.