

Varroa Mite Life Cycle

Project No.: 01-GD-02

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Objectives

- 1) Develop palatable essential oil products that can be incorporated into diets fed to honey bee colonies.
- 2) Determine if diets with essential oils are being fed to honey bee larvae.
- 3) Determine if larvae fed on diets with essential oils have reduced mite infestation levels.
- 4) Determine if mites infesting cells with larvae that have been fed diets with essential oils have reduced reproductive rates.

The Objectives stated above are modifications of the original Objectives of the proposal. The modifications were based upon discussions with the Research Committee of the Almond Board and the feasibility of some of the proposed methods to provide data in a timely manner.

Objective 1: Develop palatable essential oil products that can be incorporated into diets fed to honey bee colonies.

The first step in this study was to develop a method to feed essential oils with known miticidal activity to honey bees. We found that if the oil was microencapsulated, the bees would feed on it in a pollen cake at a rate similar to that of pollen cakes without the essential oil. Next, we determined upper limits on the amounts of the essential oils we could feed to a colony. The upper limits would be met if either the bees no longer fed on the pollen cakes with essential oil or the colony experienced deleterious effects. The oils we tested are Origanum, Bay, and Cinnamon. Currently, we are feeding 5-frame colonies 40ml of each essential oil in pollen cakes without negative effects.

Objective 2: Determine if diets with essential oils are being fed to honey bee larvae.

The second step in the study was to determine if the pollen cake we fed to the colony was getting into nurse bees and larvae. To accomplish this, we labeled pollen cakes with rabbit IgG and fed them to 5-frame nucleus colonies. We sampled nurse bees and larvae at 24-48 hour intervals and conducted an enzyme linked immunosorbant assay to detect the IgG. Within 24-hrs., the nurse bees and larvae tested positive for the IgG labeled pollen cake. As a final check that the pollen cakes with essential oils were being fed to larvae, we examined gut contents of larvae and could see the microcapsules that contained the essential oils.

Objectives 3 & 4: Determine if larvae fed on diets with essential oils have reduced mite infestation levels. Determine if mites infesting cells with larvae that have been fed diets with essential oils have reduced reproductive rates.

The efficacy of the essential oils in reducing mite infestation levels was determined by caging an area on a brood frame and allowing the queen to lay. The colony with the caged queen was fed pollen cake containing one of the following treatments: no essential oil, the diluent used to formulate the essential oil, or Bay, Origanum, or Cinnamon oil. When the eggs eclosed, the cage was removed so that the nurse bees could feed and care for the larvae. Twenty-four hours before the cells containing the larvae were sealed, the frame was transferred into a colony with a heavy mite infestation. The frames remained in the mite-infested colony until 24-36 hrs before the brood would emerge. The frames were removed and 100 cells were examined for adult and immature mites. The results are shown below (Table 1.)

Table 1. Varroa mite infestation levels in sealed worker brood.

Treatment	Total Number of Cells Examined	Number of Cells with Mites	% of Cells with Mites	Average number of	
				Adults	Immatures
Pollen Cake (no essential oil)	800	312	39.0± 3.4	1.8 a	2.9 ac
Pollen Cake (diluent for essential oil)	486	168	34.6± 4.2	1.4 b	2.2 a
Pollen Cake With Bay	300	137	45.7± 5.6	1.9 a	4.2 b
Pollen Cake With Origanum	300	139	46.3± 5.6	2.3 c	3.1 c
Pollen Cake With Cinnamon	300	68	22.7 ± 4.7	1.1 b	2.2 a
Host Colony*	800	800	42.4 ± 3.4	1.8 a	2.8 ac

Host Colony were cells examined from the mite infested colony where the frames containing larvae fed on treated pollen cakes were placed.

Of the three oils we have tested, larvae that were reared on pollen cake with Cinnamon oil had the lowest percentage of cells with mites compared with the other oils and larva reared on pollen cake without oils (Table 1.). The essential oils did not appear to influence mite reproduction at the concentration we used. The only oil that appeared to affect mite reproduction was Cinnamon, but larvae fed on the diluent had the same average number of adult and immature mites as those fed on Cinnamon.