Assessing the Value of Supplemental Forage During Almond Pollination by Longitudinal Monitoring of Honey Bee Colonies for Nutritional Status, Colony Growth and Survival

Project No.: **15-POLL15-Sagili**

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Objectives:

Evaluating effects of supplemental forage prior to and after almond bloom on honey bee nutrition, colony growth and survival.

Interpretive Summary:

Honey bee colonies employed for almond pollination face two challenges with respect to nutrition: a) lack of adequate foraging resources before and after almond bloom and b) lack of floral diversity during almond bloom. To address this nutritional stress, organizations such as Project Apis m are providing alternate forage for bees before and after almond bloom in California. To successfully implement and promote this strategy we need to understand the potential of these supplemental bee forages in promoting honey bee colony health. We measured honey bee colony nutrition, strength and survival in thirty-two colonies (total) placed in limited forage locations and colonies placed in locations with supplemental forage. Data pertaining to this study is currently being analyzed.

Materials and Methods:

Field sites: This study was conducted in southern Arizona and California. Please refer to the project report 15-POLL14-McFrederick/Meikle/Carroll for more details.

Experimental timeline 2015-2016	
Nov. 19 -23	Hive inventory and identification
Nov. 27	Maintenance feeding: 250 g BeePro patties for all hives
Dec. 7-10	Pre-treatment sampling and evaluations. Temperature sensors installed.
Dec. 11	Maintenance feeding: 250 g BeePro + 3 L 1:1 sugar syrup for all. Pollen traps placed on sentinel hives.
Dec. 24	Treatment sites not quite ready. 3 L sugar syrup given to all hives.
Dec. 30	All hives moved to respective treatment sites and placed on electronic scales.
Dec. 31 - Jan. 25	Hives in treatment plots. Hives inspected periodically to ascertain their health. Sentinel hives monitored on several occasions for pollen collection.
Jan. 26-29	Hive sampling and evaluations.
Feb. 2-4	Hives moved to almond orchard (Blackwell's Corner, CA) and installed on scales. Hives fed sugar syrup.
Feb. 4-29	Hives in CA almonds
Mar. 3-5	Hives sampling and evaluations. All hives moved to Keck's Corner (about 25 km away) for post almonds and placed on scales. Hives fed sugar syrup.
Mar. 6 - Apr. 4	Hives in post-almond site.
Apr. 4-8	Post-almond hive sampling and evaluations. All hive scales and associated equipment moved to Arizona.
Apr. 9	All surviving hives moved back to Arizona.

(Note: this experimental timeline table is courtesy of other collaborators (McFrederick, Carroll and Meikle)

Colony strength evaluations and survival
Our collaborator Dr. Meikle used his electronic scales, digital cameras and temperature sensors to measure colony strength parameters. Please refer to the project report 15-POLL14-McFrederick/Meikle/Carroll for details.

Hypopharyngeal gland protein analysis
From each collected sample, ten bees were used for hypopharyngeal gland dissection. Glands were pooled together and placed in 2ml microcentrifuge tubes containing saline buffer. We quantified protein content with the PierceTM Biotech BCA Assay Kit (Cat #23225, Thermo-Scientific, IL, USA) microplate procedure. Absorbance at 562 nm was measured using a microplate spectrophotometer (BioTek Synergy 2, Gen5 2.00 software) and protein content concentration in µl /ml was calculated from the resulting standard curve. Fifty percent of the collected samples have been analyzed for the hypopharyngeal gland protein content.

Midgut proteolytic enzyme activity
Seventy percent of the samples obtained for this study have been analyzed for the midgut proteolytic enzyme activity. The midguts of ten bees per sample were excised and placed in centrifuge tubes containing 100 µl Tris-HCl buffer (pH 7.9) each and stored at −80 °C prior to further processing. Frozen guts were crushed, homogenized in Tris-HCl buffer (pH 7.9) and, centrifuged at 10,000 rpm for 5 min to remove particulate matter. The supernatant was analyzed for total midgut proteolytic enzyme activity (casenolytic activity) as described by Michaud et al. (1995) and used by Sagili et al. (2005). Total midgut proteolytic activity was expressed in terms of OD_{440}. Total midgut proteolytic enzyme activities from each treatment will be analyzed using ANOVA and LSD.

Results and Discussion:

Colony strength evaluations and survival
Please refer to the project report 15-POLL14-McFrederick/Meikle/Carroll for details.

Hypopharyngeal gland protein analysis
The analysis is still in progress and is expected to be completed by end of October 2016. The data will be analyzed before 12-31-2016.

Midgut proteolytic enzyme activity
The analysis is still in progress and is expected to be completed by end of October 2016. The data will be analyzed before 12-31-2016.

References Cited:

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Sagili, R. R., Pankiw, T., and Zhu-Salzman, K. 2005. Effects of soybean trypsin inhibitor on hypopharyngeal gland protein content, total midgut protease activity and survival of the honey bee (*Apis mellifera* L.). Journal of Insect Physiology. 51: 953-957.