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## **Effects of Pollen Quality on Honey Bee Nutritional Status and Colony Growth**

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**Project No.:** 09-POLL2-Sagili

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**Project Cooperators and Personnel:**

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**Objectives:**

- 1) Evaluating and comparing the effects of single-source pollen consumption versus mixed-source pollen consumption on hypopharyngeal gland protein content, bee mass, lipid content, immunocompetence and colony growth in the honey bee.
- 2) Designing a field test to assess the nutritional status of honey bee colonies in the field.

**Interpretive Summary:**

In this study we found that honey bee colonies receiving single-source pollen had significantly lower protein in the brood food producing glands compared to the colonies that received multi-source pollen. Also, colonies receiving single-source pollen during the experimental period had significantly lower colony growth and immunity when compared to colonies that received multi-source pollen. Findings of this study will be helpful in suggesting appropriate supplemental feeding regimen to beekeepers to maintain optimal nutrition and hence strong and healthy colonies.

**Materials and Methods:**

Six frame nucleus colonies were used for this experiment and we had 10 replications. A pair of colonies was established by dividing a single colony and were headed by a naturally mated sister queens. A large flight cage partitioned in segments was used for this experiment. Colonies were equalized before start of the experiment and all existing pollen was removed. There were two treatments: 1) single-source pollen and 2) multi-source pollen. Powdered pollen was packed into the comb cells and surface sprayed with 50 % sugar syrup (Dreller & Tarpy, 2000 Anim. Behav. 59: 91-96). Both treatments were provided the same amount of pollen throughout the experimental period. Each week 100 newly emerged paint marked bees were introduced in to each experimental colony. Each week 20 nurse bees were obtained from each colony for hypopharyngeal

gland protein estimation and comb area occupied by eggs, larvae, pupae, pollen, honey and empty space were measured with a metered grid (Pankiw et al. 2004). Lipid content was also measured using the method of Behmer et al. 2002.

Hypopharyngeal gland protein estimation: We used 500-0202 Quick Start Bradford Protein Assay Kit 2 (Bio-Rad Laboratories, CA, and U.S.A.) for protein analysis and followed the method of Sagili et al. 2005. Standard-curves were prepared using bovine serum albumin (BSA). Protein absorbance was measured at 595 nm against blank reagent using a Beckman Spectrophotometer. Weight of protein (BSA) was plotted against the corresponding absorbance value to generate a linear regression equation that was used to calculate the protein extracted from hypopharyngeal glands.

Immunocompetence: 10 bees were obtained from each experimental colony for measuring phenoloxidase and prophenoloxidase activity, an indicator of immunocompetence in honey bees. Phenoloxidase and prophenoloxidase activities were measured by following the method of Laughton & Siva-Jothy, 2010 *Apidologie* DOI: 10.1051/apido/2010046.

Field test for nutritional status estimation: Newly emerged bees were caged and provisioned pollen diets varying in protein concentrations. Treatments included 1) no protein 2) 10 % protein 3) 20 % protein and 4) 40% protein. After 7 days, 20 bees from each cage were cold euthanized and their hypopharyngeal glands were dissected and stored in Tris buffer. Protein content of hypopharyngeal glands was determined using Bradford assay as per Sagili et al. (2005). BSA visual standard for the above treatments was developed.

## Results and Discussion:

Nurse bee hypopharyngeal gland protein content and colony growth in single-source pollen treatments were significantly low compared to multi-source pollen treatments ( $P < 0.01$  and  $P < 0.05$  respectively) (see **Figure 1 and 2**). Single-source pollen (SSP) treatments had significantly lower phenoloxidase and prophenoloxidase activity when compared to multiple-source pollen (MSP) treatments ( $P < 0.001$ ) (**Figure 3**). BSA visual standard for the four treatments (no protein, 10% protein, 20% protein and 40% protein) has been developed. We plan to compare the protein contents of field samples to this established standard.

Results from this study suggest that single-source pollen consumption for an extended period of time negatively impacts hypopharyngeal gland protein content of nurse bees. This in turn might be resulting in poor nutritional environment in the hive and negatively impacting colony growth. Also, it appears that single-source pollen consumption results in lower immunocompetence that might lead to increased susceptibility of bees to existing and new pests and diseases

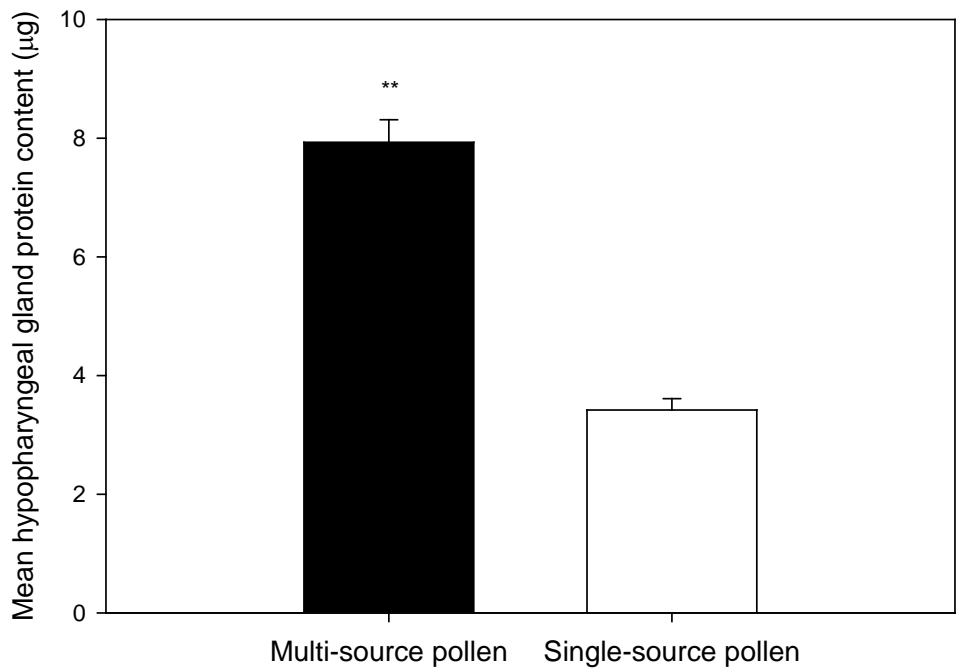


Figure 1.

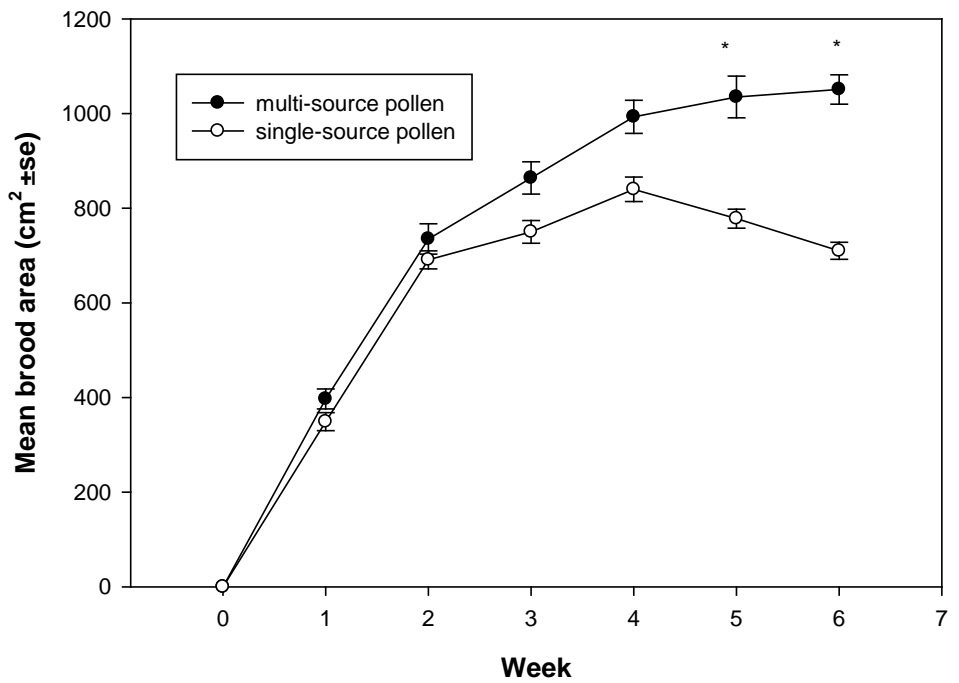


Figure 2.

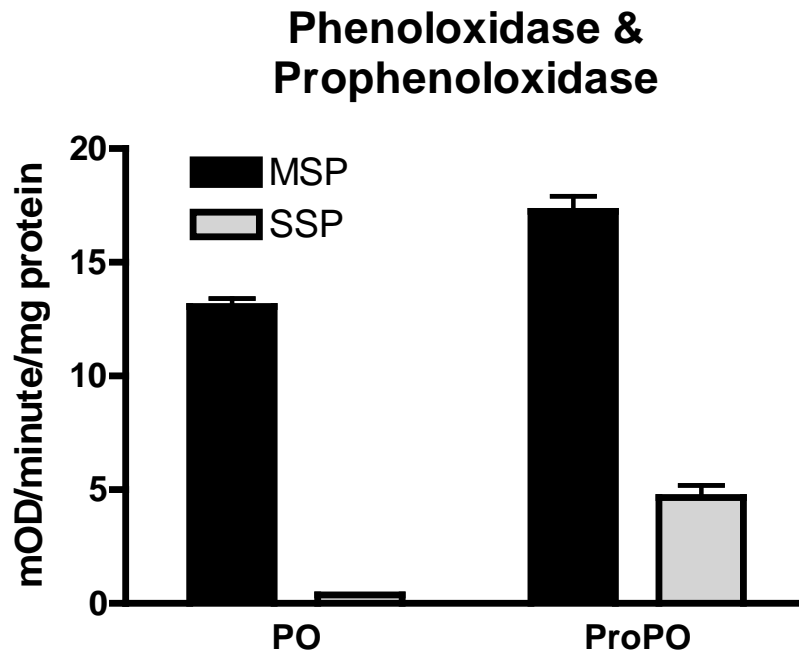


Figure 3.

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