

# Nutrition Shapes Immunity and Viral Tolerance in Honey Bees

## Background

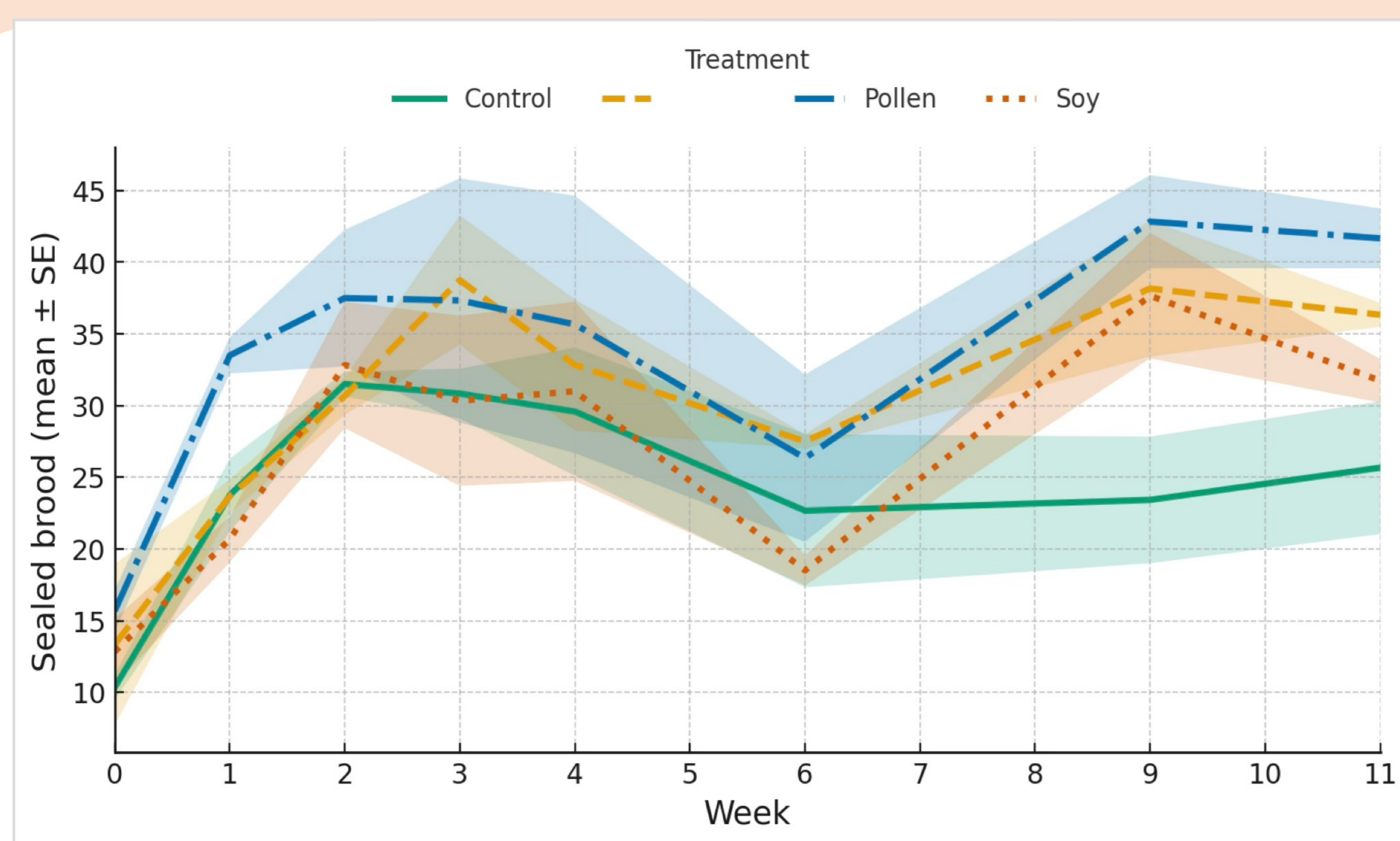
Honey bee colonies rely on diverse pollen diets to support immunity and development. Habitat loss and intensive agriculture reduce floral diversity, exposing colonies to nutritional stress. Poor diets weaken immune defenses and increase susceptibility to viruses like Deformed Wing Virus (DWV). Beekeepers use artificial substitutes, but their quality and effectiveness are rarely validated under field conditions.

## Methods

Colonies were assigned to four diet treatments: pollen, soy patty, commercial supplement (Zeina's Pro), control and monitored during an 11-week pollen dearth. Nurse bees were sampled at Weeks 0 and 11 for immune gene expression and DWV analyses.



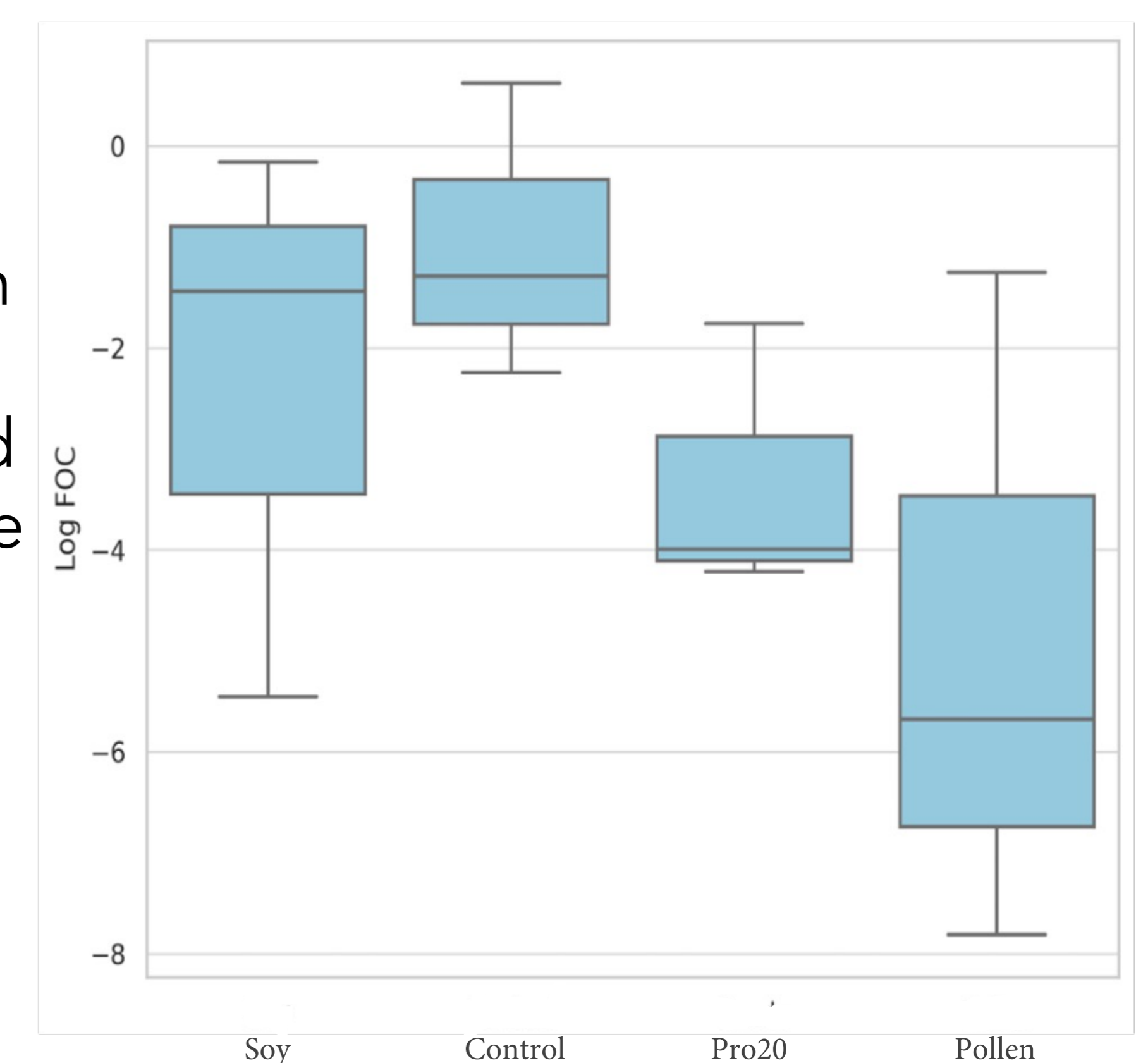
## Pollen diets sustained colony growth



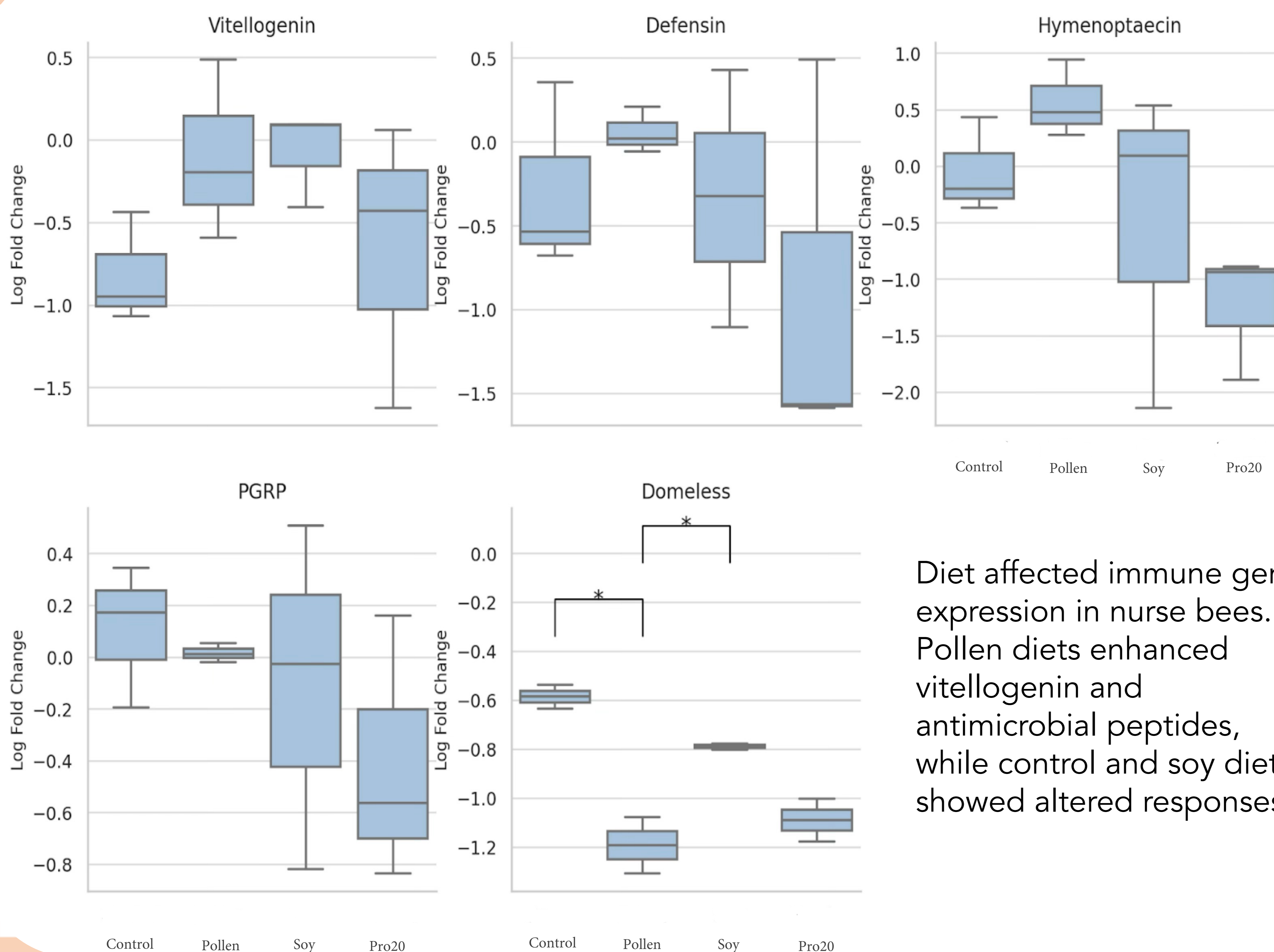
Pollen-fed colonies maintained the strongest growth during the 11-week pollen dearth. Supplemented colonies showed moderate growth, while soy and controls performed weakest.

## DWV levels were lowest in pollen-fed colonies

Pollen supplementation suppressed DWV replication. Soy-fed and control colonies had the highest viral loads, with substitutes at intermediate levels.



## Diet shaped immune gene expression



## Conclusions

Quality pollen diets sustained colony growth, affected immune gene expression, and suppressed DWV replication during pollen scarcity. These findings demonstrate that nutrition is a central factor regulating honey bee health and resilience under stress conditions.

## Next Steps

We will expand field trials across diverse regions and diets, validate molecular markers of nutritional stress, and test available supplements on the market to develop evidence-based feeding protocols for beekeepers.

Diet affected immune gene expression in nurse bees. Pollen diets enhanced vitellogenin and antimicrobial peptides, while control and soy diets showed altered responses.