

Honey bees, esteemed for their pivotal role as pollinators, confront a myriad of challenges such as: pesticide exposure, pests and pathogens, and suboptimal nutritional conditions. With a growing interest in understanding potential advantages of chemical-free and organic management systems for honey bees, a team of researchers from Penn State University developed a study to help get answers.

Dr. Margarita López-Urbe and Dr. Robyn Underwood compared three beekeeping management styles: Conventional, Chemical-Free, and Organic, in order to identify differences in:

1. the overall health and resilience of the bees and colonies
2. bee productivity, or honey yield, and
3. the cost-benefits across these three systems.

Conventional: A system that allows the use of chemicals (synthetic and natural) and antibiotics to control parasites and pathogens in colonies.

Organic: A system that only allows mechanical and non-synthetic chemical treatments to control parasites and pathogens in honey bee colonies.

Chemical-Free: A system that relies primarily on the genetics of the colony to control parasites and pathogens in honey bee colonies.



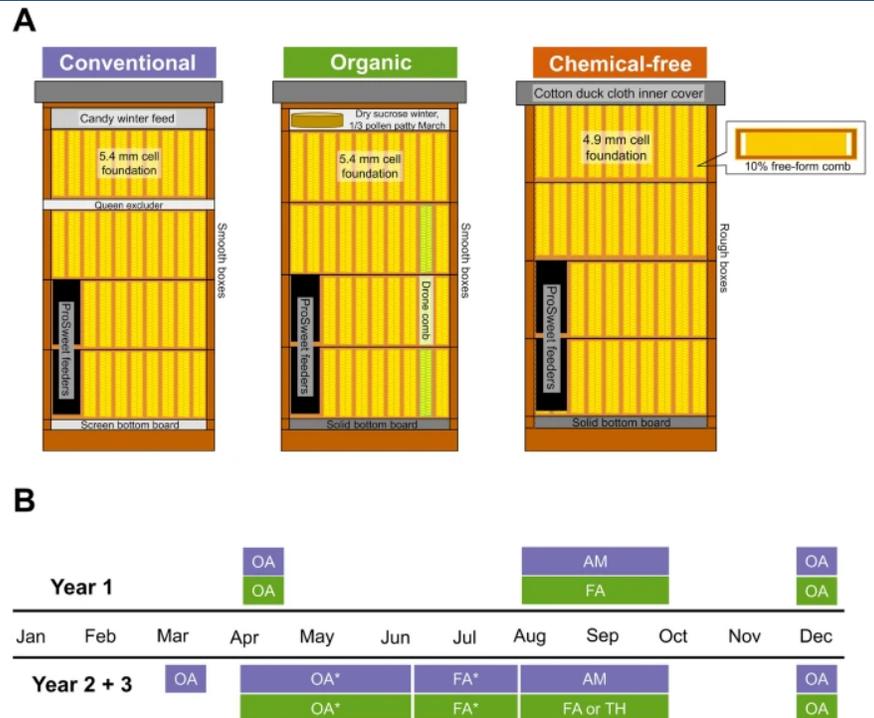
Over the course of three years, the research team worked closely with beekeepers implementing the three different management practices across 288 colonies located on 8 different farms in the Mid-Atlantic region of the United States (216 in Pennsylvania and 72 in West Virginia). To measure colony health, they regularly sampled the colonies for diseases and pests, including varroa mites, nosema, and two viruses. The research team also conducted a comprehensive costs and benefits analysis of the different management systems based on inputs and output. Funding for this innovative research came from USDA NIFA's [Organic Agriculture Research and Extension Initiative \(OREI\)](#).

WHAT DID RESEARCHERS FIND?

Organic beekeeping management is a sustainable and profitable system for stationary beekeeping operations.

Organic management for honey production had the highest yields, followed by conventional, and then chemical-free. The averages for the three years of the study were 50kg, 46kg, and 23kg for organic, conventional, and chemical-free, respectively.

Details of the equipment and treatment applications for each management system. (A) The figure depicts a cross-sectional view of each system and shows the equipment utilized in each management system. (B) The treatment timeline shows the different types of treatment used including oxalic acid crystal (OA), amitraz (AM), formic acid (FA), or thymol (TH), during year 1 (top) and years 2 and 3 (bottom) for conventional (blue), organic (green), and chemical-free (orange). Asterisks (*) indicate that the treatment was only applied if a threshold of 1% was reached.



Treating pests is essential for honey bee health.

Controlling varroa mite populations is necessary for honey bee colony survival, and organic miticides (name them) proved to be effective at controlling mite populations. Overwintering survival was on average 84% for conventional, 81% for organic, and 27% for chemical-free systems.

Organic management systems support healthy colonies without the need to apply synthetic chemicals to colonies.

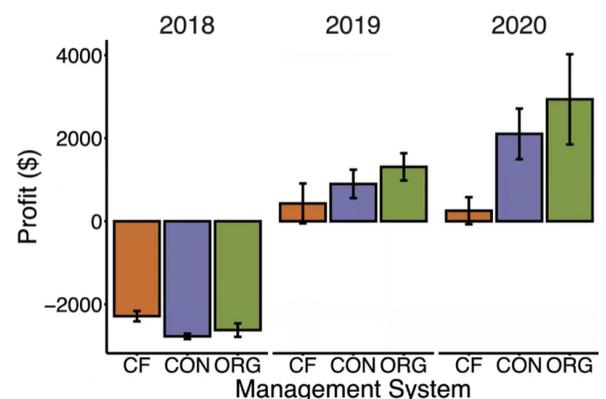
Organic management for varroa mite populations was as effective as conventional systems when managing pests. Colonies that were provided with organic or conventional interventions supported colonies with fewer mites, lower nosema, and virus levels, and lower expression of genes related to stress.

Location matters!

Honey bee hives located on organic farms show low pesticide residue in colony products.

Organic Management Is Cost Effective

The organic management system yielded the most profit, even when honey was sold at conventional prices. By year 3 of the study, the net profits per hive showed: Chemical Free (CF) \$50, Conventional (CON) \$2,000, and Organic (ORG) \$3,000 as shown in the graph below.



While beekeepers are encouraged to consider organic beekeeping management in their operation, products coming from these colonies cannot be certified as organic due to the potential exposure to pesticides from the surrounding landscape.