Does hive strength predispose honey bees to European foulbrood disease?

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Introduction:

European Foulbrood (EFB) is a bacterial disease of young honey bee larvae, caused by *Melissococcus plutonius* infection of the larval midgut. It occurs in times of nutritional stress when insufficient food is supplied to the larvae by the nursing bee population[1]. EFB increases larval mortality, thereby limiting the colony's growth, which can have consequences on the hive's pollination services, honey production, and ability to reproduce.

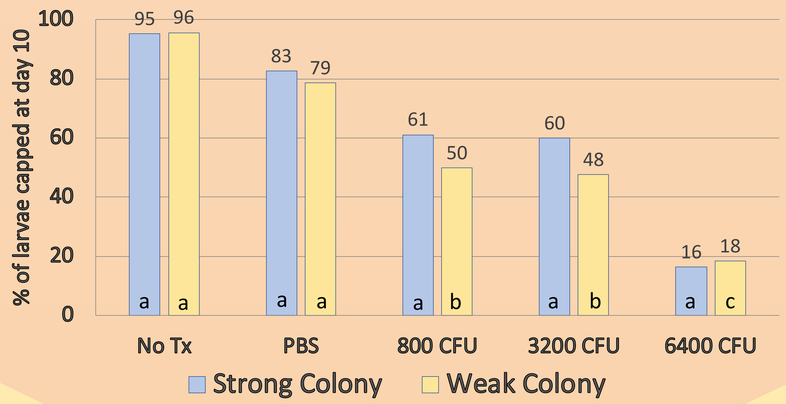
Recently, increased incidence of EFB has been observed across North America; however, the underlaying factors predisposing colonies to EFB remain largely unknown.

Objectives:

1) **Survival:** Investigate if increased larva to worker bee ratio increases larval susceptibility to EFB.
2) **Culture:** Investigate whether weaker colonies result in increased incidence of persistent pupal infection.

Results: Survival

Figure 3. Variation in hive strength does not predispose honey bee colonies to European Foulbrood Disease



Larval survival was affected by treatment dose: strong colony χ^2_4=69.6; weak colony χ^2_4=71.5, p<0.001 for both; but not by colony strength: p>0.1.

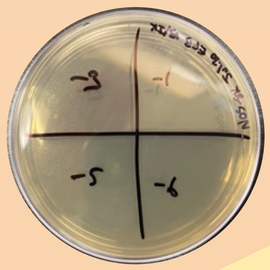
Results: Cultures

Table 1. Culture results from mature **larvae** treated with *M. plutonius* after hatching in 2021.

No Treatment	7,500 CFU
0/6	5/6

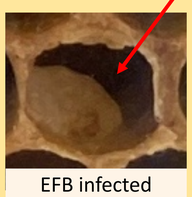
Table 2. Culture results from **pupae** treated with *M. plutonius* after hatching in 2022.

No Treatment		6,400 CFU	
Strong Colony	Weak Colony	Strong Colony	Weak Colony
0/4	0/4	0/4	0/4

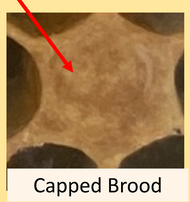


Materials & Methods:

Six-day-old larva



EFB infected



Capped Brood

In vivo hive setup

Strong Colony :	
	Empty
	Honey
	Pollen
	Half Frame of Treated Larvae
	Capped Brood
Capped Brood	
Half Frame of Treated Larvae	
Full Frame of Non-Treated Larvae	
Pollen	
Honey	
Weak Colony :	

Figure 1. A double-sided experimental hive containing two separate colonies with similar numbers of bees on either side.

Treatments:

Half Frame of Treated Larvae

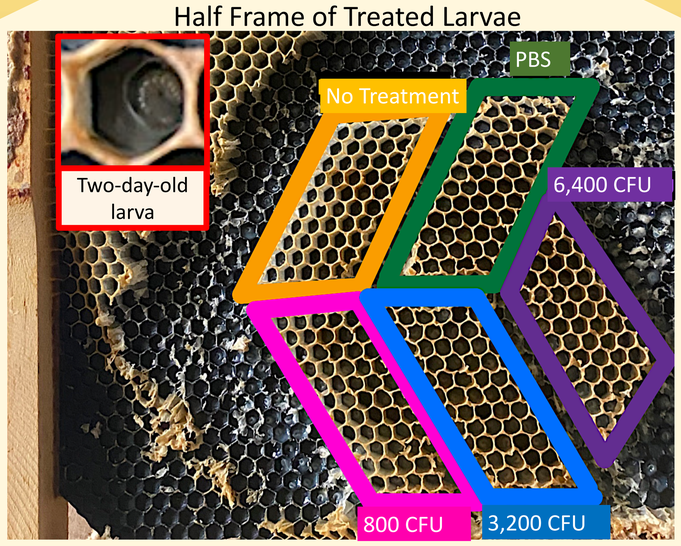
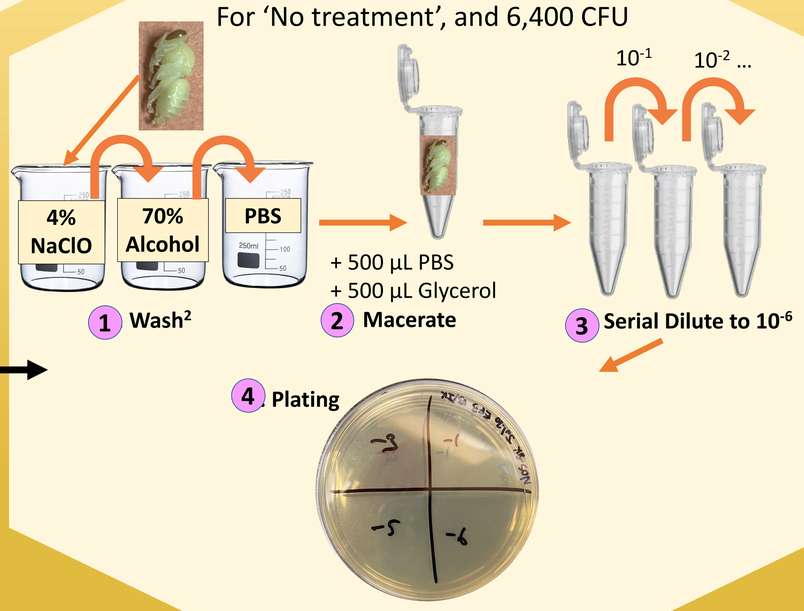


Figure 2. Treatment quadrants, each containing 50 two-day-old larvae fed 2 µL of prescribed dose. CFU - Colony Forming Units

Culturing:

For 'No treatment', and 6,400 CFU

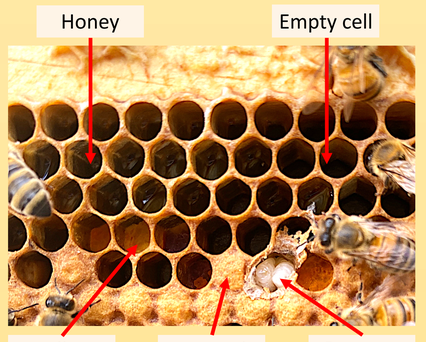


Discussion & Conclusions:

Survival: Hive strength did not predispose honey bees to EFB in our experimental model. We plan on replicating this study in new colonies to increase our confidence in this conclusion.

Culture: *M. plutonius* inoculated larvae that survived to pupation did not contain *M. plutonius* regardless of colony strength. This was unexpected since persistent infections in pupae and newly emerged bees are common in natural disease. This finding, in combination with the infected larval mortality, suggests that honey bees can effectively identify and remove EFB-infected larvae from a colony to overcome persistent infection.

Future research: Beyond creating improved replicates of this study, subsequent investigations of natural infection in pupae would be highly valuable to understand the transmission and persistence of this disease. Additionally, investigation of genetics, behavioural, physiological, and environmental variability is important to understand the factors predisposing honeybees to EFB.



Literature cited:

1. Forsgren, E., 2010. European foulbrood in honey bees.
2. Pittman et. al. 2007. 'Endomicrobia' and other bacteria associated with the hindgut of *Dermolepida albohirtum* larvae.

Acknowledgements:

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