Shaking is an Effective and Profitable Method for Managing AFB

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Figure 1. Bees shaken into a brood chamber with only foundation established quickly when timed to coincide with the spring dandelion flow.

> "As for (American foulbrood) remedies, I tried pruning out all those combs containing brood, leaving only such as contained honey, and let the bees construct new for breeding. It was "no use," these new combs were invariably filled with diseased brood! The only thing effectual was to drive out the bees, into an empty hive. In this way, when done in season, I generally succeeded in rearing a healthy stock. But here was a loss of all surplus honey, and a swarm or two that might have been obtained from a healthy one."
> -Moses Quinby, *Mysteries of Beekeeping Explained*, 1853

Moses Quinby (1810-1875) was the most successful beekeeper in his day. He is credited with being N. America's first commercial beekeeper and at his height he ran 1,200 hives in New York's Mohawk Valley, capitalising on a 15 year suspension in sugar-cane production during and after the Civil War. While he is correctly identified as the inventor of the bellows smoker, his many other contributions are overlooked, most notably his innovative and effective way of managing American foulbrood (AFB).

Quinby discovered that if adult bees from an AFB-infected colony were shaken into a new hive and forced to draw new comb, AFB would disappear. He was an astute-enough business man, however, to realise that although he saved a colony, this treatment dashed all hopes of multiplying his colonies and bringing home a good honey crop.

Quinby's contention, that shaking significantly reduced colony production, has been rarely challenged in the past 150 years. Shaking, consequently, has been relegated to a hobby-practice, particularly in the age of cheap antibiotic treatments. Even the appearance of oxytetracycline-resistant AFB and heighten consumer concern over antibiotic residues have not increased the adoption of this method. We felt the method was being given an unfair "shake", particularly in the absence of a contemporary, commercial-scale, rigorous economic analysis.

The most widely described method of shaking is the one developed by an Ontario bee inspector named William McEvoy in the early 1900s. The "McEvoy Method" involved shaking bees from an infected colony into a new brood chamber containing frames with short strips of wax foundation, rather than full sheets. In this situation the bees are forced to secrete wax to create new comb and, in the process, "use up whatever infected honey there is in (their) stomach". After "the bees begin to drop from starvation" McEvoy advocated shaking onto new equipment a second time. With two transfers and two sets of equipment we wondered if the process could be simplified, and thus, more cost-effective.

The question of whether AFB could be controlled by shaking infected bees directly onto new comb, without an intermediate transfer, was investigated in 2005 by Robert Albright, a sharp young beekeeper and summer student in our program. Robert shook bees from AFB-infected colonies directly onto new combs during our dandelion honey flow (early June). Bees were shaken onto four types of brood chambers containing: a) nine frames of foundation, b) nine frames of drawn comb, c) five frames of drawn comb and four frames of foundation and e) seven frames of drawn comb and two frames of drawn comb with brood. As a control, some bees were re-hived on the original diseased-comb (~150 AFB/cells per colony). Robert followed the infection in these colonies for a full year, not only inspecting for visible signs of the disease, but also looking for sub-clinical infections through the analysis of bees and honey for spores.

Shaking bees onto new comb or foundation resulted in an almost total reduction in diseases symptoms. While the symptoms largely disappeared from the colonies shaken onto foundation or new comb, colonies in the AFB-Control group developed increasingly severe AFB. The infection in the AFB-Control group became so acute that none of these colonies survived the winter. By contrast, all but one of the colonies shaken onto foundation or new comb survived winter. The cases of AFB among the colonies shaken onto foundation or new comb were very light, consisting of less than 10 cells of AFB, and always transitory. Only colonies shaken onto pure foundation did not exhibit symptoms of AFB on any of the inspections. Following winter, colonies shaken onto foundation or new comb had little or no spores in the stomachs of workers or in their honey stores.

Armed with the knowledge that a simplified shaking method could control AFB, in 2006 we returned to address Quinby's concern that shaking would result in the "loss of all surplus honey". We used an experiment comparing honey yield among three groups: 1) colonies established from packages (PACKAGE), and colonies wintered in single brood chambers and either: 2) shaken into a brood chamber of foundation (SHAKEN) or 3) left on the original brood comb (WINTERED). There were twelve colonies per treatment group and all colonies were free of AFB. The Package treatment group was established on 24 April 2006 with 2 lb of bees obtained from Australia. The colonies in the Shaken and Wintered groups were both derived from colonies wintered indoors in single Langstroth brood chambers. The Shaken colonies were established prior to the dandelion nectar flow onto nine frames of embedded wax foundation on 12 May 2006. We measured honey yield on each colony through the summer.

The colonies shaken onto foundation established rapidly, despite having their original comb and brood removed. Only a month after the bees were shaken they had drawn an average of 4.2 ± 0.3 (± SE) frames of foundation (Figure 1). Furthermore, by this time the colonies in the Shaken group already had a comparable sealed brood population with the colonies in the other treatments, although they had 1.7 times fewer adult workers compared to the wintered colonies. Most of the foundation in the shaken colonies was fully drawn by the onset of the honey flow, which was slightly less than 2 months after establishment.

The total weight of honey harvested from the wintered colonies was 1.4 times greater than that harvested from the shaken colonies (Figure 2). The difference in total yield among the treatments, however, stemmed from higher yields only during the earliest harvest (pull). During this first harvest, shaken colonies produced no honey, whereas the wintered and shaken colonies produced 21 and 10% of their total yield, respectively. By the second harvest, however, the shaken colonies achieved the production of the colonies in the other two treatments and maintained their level of productivity for the remainder of the season. A comparison to historical weight gain data collected at Beaverlodge indicates that the 2006 honey flow began at least two weeks earlier than average and extended longer into August.

We used this honey yield data to conduct an economic analysis of possible spring AFB-control methods for oxytetracycline-resistant strains. We compared the profitability of the 1) Shaken treatment to: 2) killing the infected colony and not replacing it and 3) killing the infected colony and replacing it with a package. Presently there is no antibiotic registered for medicating oxytetracycline-resistant AFB in the spring. These scenarios were also compared to 4) not having AFB (Table 1).

Although the No AFB group yielded, on average, 55% higher profits compared to the Shaken group, the Shaken group yielded 25% higher profits compared to the Package group (Table 1). These results suggest that if Moses Quinby were keeping bees on the Canadian prairies today, his 21ts Century beekeeping empire would undoubtedly manage cases of AFB found during the spring build-up using the simplified shaking technique described here.

Figure 2. Honey yield per colony (Experiment 2, 2006). The narrow shaded bars represent the average colony honey yield across each of four pulls. The wide black bar represents the total honey yield. Treatments followed by the same lower-case letter indicate no significant difference in yield (n=12, black letters = total pull, white = first pull; Tukey Kramer HSD, *P* = 0.05).

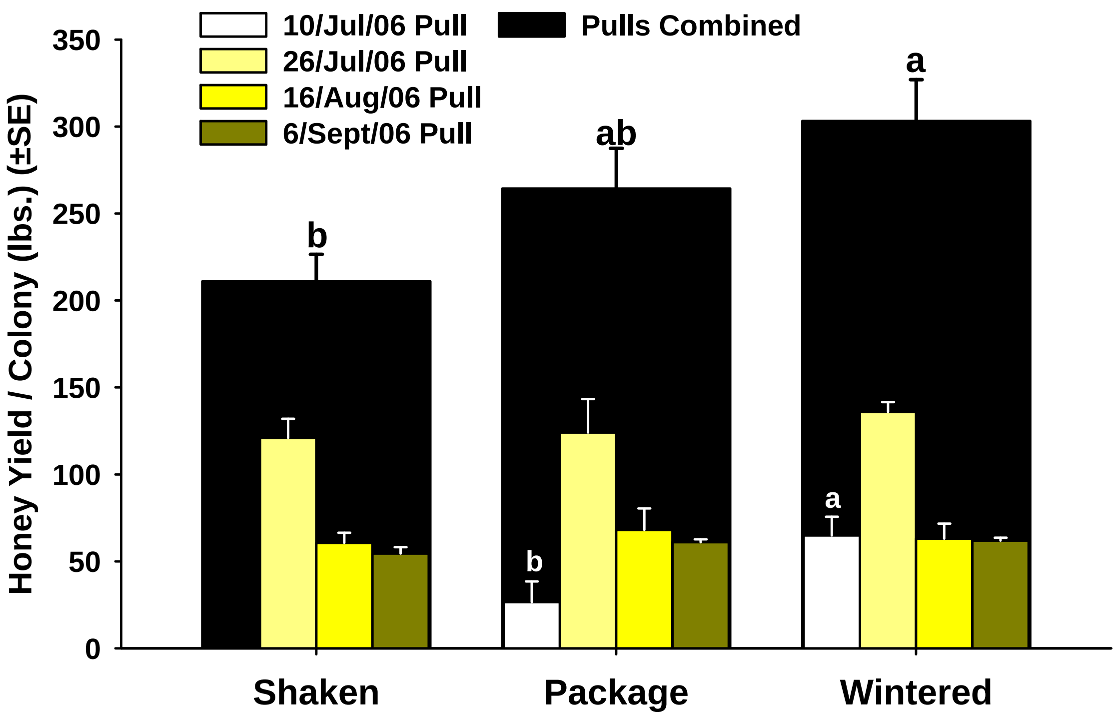

Table 1. Economic analysis of the four strategies for dealing with a case of American Foulbrood in the spring (based on data from Experiment 2). All figures in Canadian Dollars ($1 CND = $0.87 USD, November 2006).

	Honey Revenue[1]	Operating + Labour Costs[2]	Cost of Package[3]	Frames[4]	Residual Value (Fall)[5]	TOTAL
Kill Colony	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Kill Colony and Buy Package	$264.32	$116.83	$87.45	$28.00	$130.00	$162.04
Shake	$210.90	$116.83	$0.00	$19.26	$130.00	$204.81
Healthy (wintered)	$303.13	$116.83	$0.00	$0.00	$130.00	$316.30

1 – Bulk sale of honey $1.00 per lb.
2 – Per colony operating and labour costs from Manitoba Agriculture (2006).
3 – Price for ½ of a 4 lb Australian package with two queens.
4 – A frame of foundation includes assembly costs and was $2.14 per frame. The cost of a frame of drawn comb was $3.00 per frame.
5 – Residual value from Manitoba Agriculture (2006)