AMERICAN FOULBROOD DISEASE

From R.M. Goodwin, J.H. Perry and H. Haine.

Part 1. The Incidence of American Foulbrood Disease in New Zealand.

American foulbrood (AFB) disease is caused by the bacterium *Bacillus larvae*. The disease was first recorded in New Zealand in 1877, 38 years after honey bees were introduced, and by 1887 had spread throughout New Zealand[1].

Accounts of the levels of AFB in the early part of this century are very sketchy. This was mainly due to the practice of managing AFB rather than destroying contaminated colonies. Colonies that had light infections were "shook swarmed". This entailed shaking the bees from infected colonies into hives that only contained foundation and was often effective at eliminating the disease. Only colonies with heavy infections were destroyed. Because of this, all the early reports only record the number of heavily infected colonies.

Some of these early attempts at management make interesting reading; Isaac Hopkins[1] wrote:

The districts in which the Ruakura State Apiary is situated were amongst the worst in the Dominion for foulbrood. The colonies I started the State Apiary with that were already on the farm were affected. By constant attention and treatment we were able to keep the disease from spreading and when we left for the Christchurch Exhibition there were six out of over 70 slightly affected with foulbrood. When we retuned in the following June we found the disease had spread through robbing to nearly every colony. Early in the following season we treated a number of the worst cases and replaced bad with clean combs. As this did not turn out so satisfactory as we hoped, I hoped to treat the whole of the colonies the next spring. The result was very satisfactory indeed, for although we still get a touch of disease in one or two colonies every season, by strict vigilance it gives us no trouble.

The first reliable report on the incident of AFB in New Zealand was in 1947. Seventy four percent of all the colonies in New Zealand were inspected and 1.7% were recorded as infected with AFB[2]. In 1950 78% of the colonies were inspected and 2.02% found to be infected[3].

It was decided after the 1950 survey that the incidence of AFB could not be reduced if shook swarming was continued. Beekeepers were instructed by the Department of Agriculture to 'destory the contents of all diseased hives, and to sterilize thoroughly any remaining hive equipment by approved methods'[3].

TABLE 1
Incidence of *B. Larvae* spores

	Hives	% Positive
Hobbyist Total	355	11.1
North Island	279	10.8
South Island	76	11.8
Commercial	1681	8.3
Feral colonies	106	6.0
Honey Total	32	25.0
North Island	22	31.8
South Island	10	10.0

There were no reliable disease data between 1950 and 1960. In 1961 only 0.23% of colonies were reported to be infected. This decline since 1950 was possible due to the move away from managing AFB, i.e., shook swarming, to destroying colonies infected with AFB disease. The percentage of colonies reported to be infected has increased by 522% from 1964 to the present (Fig. 1). The number of colonies burnt has increased even more (836%), from 446 in 1964 to 3,733 in 1991, due to the increasing number of hives.

The reasons for the increasing levels of disease that is being reported is unknown. A number of ideas have been advanced ranging from beekeepers looking harder, to the changes required in beekeeping practices to prepare hives for kiwifruit pollination. One hypothesis that has some support is that it is related to the increasing numbers of hives in New Zealand (e.g., Fig. 2). The increase in the percentage of infected colonies appears to follow closely the increase in the number of colonies in New Zealand, with a two year time delay. Whether this does reflect cause and effect is unknown.

All the information on the levels of AFB in New Zealand must be treated with caution. The figures rely heavily on the information provided by beekeepers to the Ministry of Agriculture and Fisheries. Even though it is a statutory requirement for beekeepers to inspect all colonies in New Zealand each year and report any that are diseased, not all colonies are inspected, and not all cases of disease are reported when found. The disease statistics must therefore be an underestimate of the actual disease levels. Whether they are a slight or large underestimate is unknown.

The initial aim of our research programme was to investigate the incidence of AFB in New Zealand. The first problem was to decide what actually constituted an infected colony. MAF considers a colony with one or more larvae or pupae exhibiting AFB disease symptoms to be infected with AFB. However, what about colonies that contain *Bacillus larvae* spores (the causative agent of AFB disease), but do not contain any obviously diseased larvae?

TABLE 2
Number of colonies tested for each beekeeper
and the number that tested positive.

Beekeeper	Hives	% Positive
A	400	9.3
B	422	81.8
C	200	10.0
D	200	6.5
E	200	24.5
F	200	0.5
G	200	6.0
H	281	2.8

We decided to look for colonies that contained *B. larvae* spores rather than those that contained obviously diseased larvae. To do this we tested bees and bee products for the presence of *B. larvae* spores by spreading the material to be tested on bacterial plates and looking to see how many *B. larvae* colonies grew. The test is quite sensitive and will detect spore levels which

are too low to cause infections. Therefore, the presence of *B. larvae* spores in bees, bee products or equipment doesn't necessarily mean that the colonies will show AFB symptoms. This must be remembered when the results are interpreted. The relationship between *B. larvae* spores and diseased larvae will be discussed in a later article. It is also important to remember that in looking for spores it is obviously not possible to find every one. Just because we were unable to find spores in what we were testing this may not mean that there were none, but just that there were too few to be detected. Likewise any spore loadings described are only relative estimates rather than actual numbers.

We investigated a number of hobbyist, commerical and feral colonies for the presence of *B. larvae* spores. We also investigated a number of lines of honey for spore contamination.

HOBBYIST COLONIES

We tested samples of adult bees from 355 randomly selected colonies belonging to hobbyist beekeepers taken from both the North and South Islands. Most of the hives were in city areas. A total of 11.5% of the colonies tested positive for the presence of *B. larvae* spores. The incidence in both islands was similar (Table 1).

The relatively high percentage of colonies testing positive is interesting in that most of the hobbyists had only one or two hives. There is therefore little chance of the spores having found their way into the hives through cross contamination from the swapping of hive parts, as may occur in a commerical operation. This suggests that most of the spores were either produced inside the hives or were being brought in by the bees rather than being placed there by the beekeeper.

COMMERCIAL COLONIES

The survey of commercial beekeepers was not random because we were collecting the data for another reason. This point needs to be remembered when interpreting the results. We only surveyed beekeepers who had a history of having colonies infected with AFB, which would probably have produced an over-estimate. Although we sampled a large number of hives they only came from a few beekeepers which resulted in the high disease status of some of the beekeepers greatly affecting the average.

The beekeepers who supplied the hive samples were mostly from the North Island. There was a wide range in the percentage of colonies that tested positive (Table 2). If we exclude Beekeeper B whose colonies had a significant AFB problem, 8.3% of the colonies tested positive for the presence of *B. larvae* spores.

FERAL COLONIES

Bees from 106 feral colonies were tested. These were mainly collected from the Waikato; however samples were taken from as far afield as Kerikeri and Invercargill. Six percent of these tested positive.

Although feral colonies are probably a disease problem in some areas this result suggests that they may be as bad as many suppose. This is supported by the observation that a number of commercial beekeepers are able to maintain relatively disease free outfits alongside feral populations.

HONEY

Thirtytwo pots representing different lines of honey were purchased from shop shelves and tested for the presence of *B. larvae* spores. Eight of them (25%) tested positive (Table 1). All but one of the positive honey pots were packed in the North Island; however the North Island packs could have incorporated honey from the South Island.

The 25% incidence of *B. larvae* spores in honey does not of course indicate that 25% of colonies are infected or 25% of beekeepers extract infected honey. The honey from one infected super has the potential to infect a large amount of honey. Whether the concentration of spores found in the retail packs represents a potential disease risk is not known.

The incidence of *B. larvae* spores in honey does suggest that significant amounts of honey are being removed from AFB colonies, either intentionally or unintentionally, extracted and sold. If it is being done unintentionally the wet supers will have been placed back onto clean colonies.

CONCLUSIONS

It would appear from this data that *B. larvae* spores are much more common than the national disease statistics would suggest. Whether this represents the normal situation, or is a reflection of increasing disease levels is unknown. How this incidence data relates to colonies showing disease symptoms will be discussed later.

References

1 Hopkins, I. 1915: Forty two years of beekeeping in New Zealand 1874 - 1915. Some reminiscences. New Zealand Farmer stock and station Journal Dec 1915.

2 New Zealand beekeeper August 1948 P22

3 New Zealand beekeeper August 1950 P16

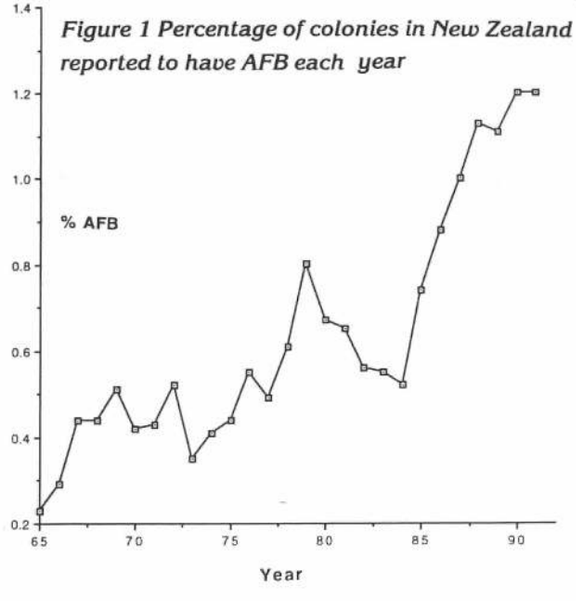

Figure 1 Percentage of colonies in New Zealand reported to have AFB each year

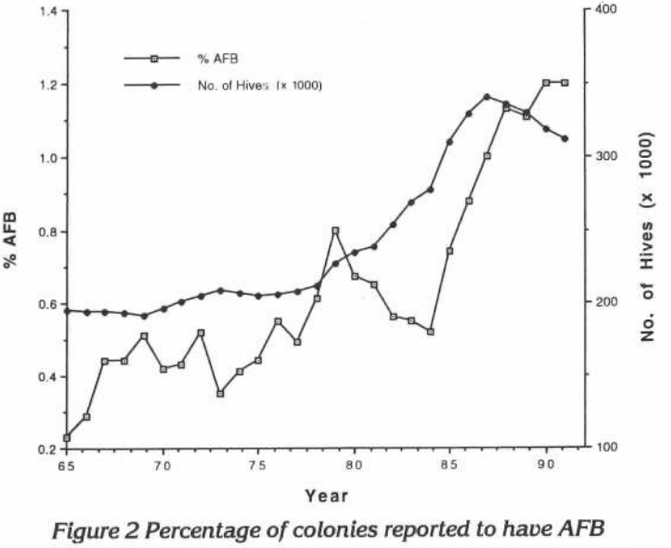

Figure 2 Percentage of colonies reported to have AFB each year and the number of colonies in New Zealand