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for Apiculture

Evaluating the effect of feeding pollen substitute to honey bee colonies destined for wild blueberry pollination in Colchester County, Nova Scotia

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INTRODUCTION

Wild blueberry (*Vaccinium angustifolium* Aiton) is a regionally important crop in eastern Canada that requires insect-mediated cross pollination for fruit set. Many blueberry growers rely on honey bees (*Apis mellifera*) as the dominant pollinator for their crops due to their versatility, efficacy, and convenience. Wild blueberry pollination is a significant source of income for beekeepers in eastern Canada, however, there has been a recent surge of reports from local beekeepers regarding the health of their honey bee colonies once they return from pollination. Anecdotal reports from beekeepers suggest that hives that return from blueberry pollination are typically weaker than when they were sent to fields. Many of these reports suggest that colonies reduce in size during pollination, and some report that hives develop European foulbrood (*Melissococcus plutonius*) (EFB) during blueberry pollination. EFB is often cited as a stress related disease, and is considered more problematic when forage is sporadic or limited, or when other stressors including hive movement, climatic conditions, or poor nutrition are at play (Bee Aware, n.d; Forsgren, 2010). Honey bee colonies may experience these negative conditions in certain blueberry fields in eastern Canada. It is therefore of interest to test potential solutions to help insure that colonies sent to wild blueberry pollination return strong and disease-free.

The objectives of this trial were to 1) determine the effect, if any, of providing pollen substitute to honey bee colonies during blueberry pollination on the growth of colonies, and 2) to determine the prevalence and severity of EFB of colonies fed different amounts of pollen substitute during blueberry pollination.

METHODOLOGY

This trial was conducted in the spring of 2019 in three wild blueberry fields in Colchester County, Nova Scotia during pollination. Sixty hives belonging to the same beekeeper were used in the trial. The test colonies were housed in wooden Langstroth hive boxes and were sent to blueberry pollination as two deep brood chambers and a medium honey super.

The trial was constructed as a randomized block design. Each of the 60 test colonies were randomly assigned to one of three equally proportioned treatment groups. Blueberry field was used as a random blocking factor to account for variation among fields. The trial was set up as an imbalanced design, where 12 hives (four replicates of each treatment) were present in the first field, 12 hives (four replicates of each treatment) were present in the second

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field, and 36 hives (12 replicates of each treatment) were present in the third field. The imbalance of the design was due to the different sizes of blueberry fields since hives were stocked in each field at approximately two hives per acre.

On the evening of 3 June 2019, the host beekeeper delivered hives to the blueberry fields for pollination. On 4 June 2019, the initial colony strength assessments were conducted by counting the seams of bees in each hive (Nasr et al., 1990). At the same time, three frames of brood in each colony in the top brood chamber were observed for the presence of EFB, and rated based on the severity observed (low: 1-4 infected larvae per brood frame, moderate: 5-9 infected larvae per brood frame, high: 10+ infected larvae per brood frame). The frames that were observed for the trial were marked with an 'X' using a permanent marker so that the same three frames could be examined again at the end of pollination, and three weeks post-pollination. After the colony assessment, colonies either received no pollen patty which served as the control, 1 lb of pollen patty, or 2 lb of pollen patty. For colonies receiving pollen patty, the patty was placed on the top of the second brood chamber and below the honey super. The pollen patty brand used in this trial was Ultra Bee™ (Mann Lake Ltd., Minnesota) due to its wide spread use in Maritime beekeeping operations, representing a "standard" pollen substitute.

During blueberry pollination, bottom mount pollen traps (Pollen Depot, Port Hope, Ontario) were deployed on colonies in each treatment group in each field to determine if the amount of pollen and the percentage of blueberry pollen collected per treatment varied among treatments. Pollen traps were deployed on 17 June 2019 for 24h. On 18 June 2019, the pollen traps were removed from the colonies, and the pollen was collected, cleaned and stored in a -18°C freezer. Pollen analysis will take place during the winter and ATTTA will share results once completed.

Just before the hives were removed from the fields at the end of pollination on 19 June 2019, final seam counts were conducted and the three frames that were previously marked were assessed for the presence and severity of EFB infection. With the exception of a few hives, hives that were fed either 1lb or 2lb of pollen patty had consumed all that was fed during pollination. Any hives that swarmed or became queenless during pollination were removed from the trial (one in control, two in 2lb group).

Approximately three weeks after hives were removed from the blueberry fields and placed in summer bee pasture (11 July 2019), colonies were further assessed for presence and severity of EFB. Colony growth was not assessed at this time due to the host beekeeper splitting hives immediately after blueberry pollination. The frames marked for EFB inspection were not removed from the parent colonies when hives were split after blueberry pollination.

Colony strength data were analysed using a general linear model in Minitab 18 (Minitab, 2018) using treatment as a fixed factor, and blueberry field as a random blocking factor. The prevalence of EFB was calculated by dividing the number of hives that displayed EFB symptoms by the number of hives in the treatment group, and multiplied by 100.

RESULTS

There was no significant difference in the growth of colonies that were fed 2lb of patty (mean = 5.83 seams, SEM = 0.63, range = -0.17 – 9.69 seams, n = 18), 1lb of patty (mean = 4.38 seams, SEM = 0.79, range = -2.00 – 7.23 seams, n = 20), or control colonies that were given no pollen patty (mean = 4.34, SEM = 0.57, range = 1.00 – 9.36 seams, n = 19) during the blueberry pollination period ($F_{2,52} = 0.63$, $P = 0.537$) **(Figure 1)**.

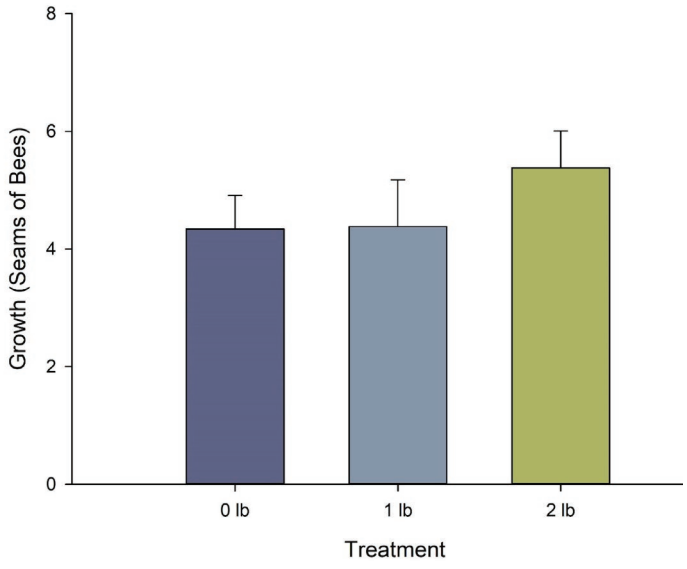

Figure 1: Mean honey bee colony growth during blueberry pollination in Colchester County, Nova Scotia, 2019 among groups fed 0, 1, or 2lbs of pollen. Error bars represent standard error.

At the onset of the trial, none of the hives were observed to have visual symptoms of EFB infection. By the end of pollination, there were only 2 out of 57 hives (3.5%) that displayed any symptoms of EFB, both with a low severity rating (1-4 infected larvae per brood frame) (Figure 2). One of these hives was in the control group, and the other was in the 2lb treatment group. Three weeks after blueberry pollination, additional hives displayed EFB symptoms, and the level of severity was much higher. Three weeks post-pollination, 4 out of 57 hives (7.0%) displayed symptoms of EFB with a high severity level (10+ infected larvae per brood frame) (Figure 2). Of the hives that were observed with EFB symptoms 3 weeks post-pollination, three of the hives were from the control treatment group (15.7%), and one hive was observed in the 2lb treatment group (5.5 %).

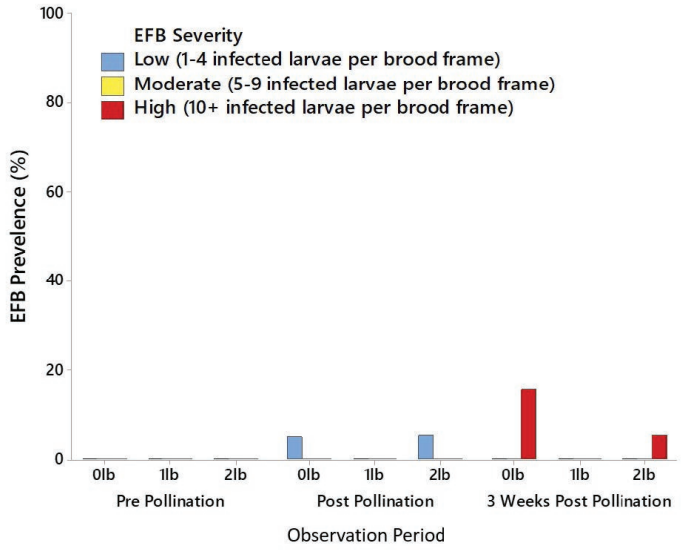

Figure 2: European Foulbrood prevalence and severity rating of honey bee colonies pre-pollination, post-pollination and three weeks post-pollination in Colchester County, Nova Scotia, 2019.

DISCUSSION

This trial aimed to evaluate the effect of feeding pollen substitute to honey bee colonies on the growth of colonies and the prevalence and severity of EFB. Our data show that feeding pollen substitute to colonies during blueberry pollination did not influence colony size and did not have an appreciable impact on reducing the prevalence and severity of EFB either post-pollination or three weeks post-pollination.

Although these results suggest that there is no economic benefit of sending bees to blueberries with pollen patty with respect to colony growth, beekeepers should be aware that surrounding floral resources and weather can impact colony growth and therefore beekeepers must make management decisions based on a variety of factors. The results of this trial are based off of one year of observation. Weather and floral resource availability can vary from year to year, and therefore we intend to repeat the trial over multiple years to try to obtain a greater understanding of the effect of feeding pollen substitute during multiple blueberry pollination seasons. For example, wild blueberry pollination in 2019 was completed in a relatively short time frame compared to other years. The pollination period lasted 16 days for this trial while in some years, pollination can last 21-24 days, depending on weather conditions. The weather in 2019 was favorable for foraging activity for most of the days that the hives were in pollination. In other years, poor weather during pollination can result in bees remaining inside hives, limiting foraging activity. In cold wet years, pollen substitute may give hives an added advantage of protein inside the hive so they can continually rear brood during times of poor weather. The blueberry fields that were used in this trial were coincidentally located in areas with a variety of alternative forage (apples, cherries, dandelion, etc.) surrounding the fields, giving bees sources of attractive, nutritious pollen to balance the incomplete diet gathered from blueberry pollen (Colwell et al., 2017). Furthermore, the cold wet start to spring in 2019 resulted in a delay in bloom of many flowers, and therefore the bloom of many alternative flowers coincided with blueberry bloom for this particular season. This meant that the bees had access to many other sources of nectar and pollen to collect along with blueberry pollen. These factors may explain why there was no apparent benefit of colony growth during pollination. At the end of the trial, the host beekeeper had to split colonies right away to attempt to prevent swarming. Despite being fed pollen sub or not, hives in the trial grew very well during the short pollination period this season. The trend commonly reported by beekeepers that hives do not grow, or reduce in size during pollination, was not observed during this trial. This may be a result of optimal foraging conditions during pollination, or due to the abundance of alternative forage surrounding the blueberry fields used in the trial. The host beekeeper sent hives to pollination meeting or exceeding the recommended pollination standard for Nova Scotia (Nova Scotia Beekeepers Association, 2012). If hives do not meet or exceed this standard, they may require additional resources such as pollen patty in order to reduce the potential negative effects during blueberry pollination. It is possible that if hives were sent below the pollination standard, there may have been a positive effect of feeding pollen patty (e.g. colonies had a greater need for pollen, and responded as such). Furthermore, weaker hives may have a higher occurrence of EFB post-pollination and three weeks post-pollination due to stress associated with pollination.

During this trial we did not notice many hives that were infected with EFB. Immediately after pollination, only 2 hives out of 57 were found with any EFB symptoms, both of which were not severe (1-4 infected larvae per brood frame). Interestingly, we did notice more EFB once the hives were placed in summer pasture three weeks after blueberry pollination, and the level of severity was much higher (10+ infected larvae per brood frame). During the three week post-pollination period, two additional hives that were from the control group were found with high levels of EFB. However, only 4 hives out of 57 hives total were found with any level of EFB three weeks post-pollination. All of the hives that contracted EFB during pollination or after pollination were from the same blueberry field, and all of the hives with EFB also showed signs of a moderate level chalkbrood infection as well. The data from this trial suggest that there may be a benefit of adding pollen patty to hives for blueberry pollination to

reduce the chances of developing EFB symptoms during or after pollination based on the higher incidence of EFB found in the control colonies. However, it is difficult to draw conclusions based on such a small sample of hives that contracted EFB. It is also interesting that all of the hives that developed EFB were from the same blueberry field and these hives were also exposed to stressors from chalkbrood as well. This may suggest that hives placed in certain fields may be more prone to developing EFB than others based on environmental stressors such as a lower abundance of alternative forage. It is also possible that because EFB is a nutritional and stress-related disease, that the colonies which had chalkbrood may have developed EFB due to the added stress of dealing with chalkbrood. Further research is required in fields with poor alternative forage surrounding the blueberry fields to determine if there is a benefit of sending bees to pollination with pollen patty.

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