ALBERTA TECH TRANSFER PROGRAM

FINAL REPORT: SUMMER-MATED QUEEN OVERWINTERING

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INTRODUCTION

Every year Albertan beekeepers work diligently to stay in business with healthy bees, as the health of Alberta's bees has been in decline. Since 2006-07, beekeepers in Alberta, and across Canada have lost an average of 25.9% and 25.7%, respectively, of their colonies every winter. Honey bee health is challenged on many fronts, while at the same time honey prices remain low. Honey bees act as a host for a multitude of pathogens and parasites, and although the causes of colony overwinter mortality are multifaceted, Alberta commercial beekeepers have reported "poor queens" as one of the top four causes of colony mortality since 2015. Albertan beekeepers clearly recognize that the competitiveness of the industry is in part driven by the quality of the queen and the genetics that she carries; and therefore, the need to be able to increase production and supply of high quality local queens.

Studies investigating management techniques for long-term storage of queens over the winter were first studied in New Zealand in 1967, as a way to increase the supply of locally produced queens to beekeepers in early spring. Since then, other countries, such as U.S.A and Canada, have carried out research to develop a successful system for storing summer-mated queens over the winter either in small colony units (nucs) or queenless colonies (queen banks); however, most early studies had limited success. More recently, studies from British Columbia, Ontario and Quebec testing slightly modified management techniques proposed key management features to successfully overwinter queens in banks. These studies concluded that high worker population is crucial for successfully banking queens over the winter, and that high queen survival rate can also be achieved by maintaining the indoor overwintering room temperature higher than what has been tested by previous studies. Winter survival of colonies largely depends on colony condition prior to winter (e.g., population size and adequate food supply); which, in turn, varies depending on the winter season duration. The moderate winter climate and season duration of the studied areas in British Columbia, Ontario, and Quebec will require some modifications to previous published methods to adapt these storage systems and management practices to the Alberta winter season. Beekeepers in Alberta recognise that they need the same capacity to increase local queen production, as in other Canadian provinces, and have higher supply of high quality queens available in early spring to support the local demand. It is based on this need that we propose to develop and implement best management practices to successfully overwinter summer-mated queens en masse in Alberta. As the major honey producing province in Canada, and home of approximately 40% of the total Canadian honey bee population, it is crucial to promote Albertan self-sufficiency in queen production, as a way to improve the local genetic stock and to protect the industry and agriculture sector from the high volatility associated with border closure.

METHODS

This experiment was carried out during the winter of 2020-2021 in two locations in Alberta: southern and central Alberta. In late August - early September, 160 queens reared from local breeder colonies and open mated with the local drone population were purchased from Alberta queen producers. Mated queens were placed in wooden cages and stored in queenless banks. Healthy and strong colonies were selected at the end of nectar flow, and the original queens were removed in September to be stored in a separate queen bank system. 24-48 hrs after their removal, the caged newly mated queens were introduced to the center of the hive in modified frames. Each queen bank was over-populated with adult bees, brood, and extra honey stores according to recommendations for overwintering queen banks. A subset of mated queens was sacrificed to evaluate queen sperm viability prior to overwintering. During the 7-month storage period (mid-September to mid-April), queen banks were kept in environmentally controlled rooms at 15-18 °C. Overwintering rooms and in-hive temperature were monitored using data loggers. Queen banks overwintering were monitored monthly and additional feeding was provided when needed. In April, a subset of surviving queens were sacrificed for post-winter evaluation of queen sperm viability.

In addition to overwintering successfully, stored queens must be of high quality and show good performance. When colonies are requeened with queens that are stored for several months, the queen should be accepted by colonies and should not show inferior egg-laying performance relative to queens overwintered in their own colonies or newly mated queens.

Summer-mated overwintered queens were introduced to new colonies in the spring of 2021. Overwintered queens' reproductive performance was assessed by estimating brood population, colony weight, honey production and pathogen level, and comparing these to those of newly-mated imported queens. Additionally, winter survival during the 2021-2022 winter was also evaluated.

Queens in individual cages, ready for overwintering.

Summer-mated overwintered queen, marked blue.

Modified frame holding queen cages.

RESULTS

Our preliminary statistical analysis of the data shows low summer-mated overwintered queen survival (18%), compared to recent studies in Quebec, but similar to previous studies from Ontario. Additionally, summer-mated queens had significantly lower sperm viability post-banking compared to pre-banking. In the spring of 2021, 22 of the 27 surviving summer-mated overwintered queens were introduced to colonies and their performance was evaluated throughout the year and compared to newly mated queens. Our results show that brood solidness, sealed brood population, honey production and varroa levels were similar between summer-mated overwintered queens and newly mated queens.

We are in the process of writing a scientific publication of this work, to be published in the future.

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