



ATTA
Atlantic Tech Transfer Team
for Apiculture



HOW DROUGHT CONDITIONS IN THE MARITIMES CAN IMPACT HONEY BEES

Developed May 2020 by J. Harrison, R. McCallum and J. Shaw

Drought conditions are putting increasing pressure on honey bee colonies in the Maritimes. Read on to find out why this matters to beekeepers and blueberry growers in our region.

Climate change has caused drought conditions to become more common all over the world, and pollinators are not immune to these changes. The local impacts on pollinators such as honey bees can be detrimental and are important to monitor. Drought conditions can affect honey bee health, survivability, pollination costs and efficiency, honey production, sustainability of commercial beekeeping, and agriculture. It is important to understand the effects of drought, recognize signs of distress in colonies, and be proactive in management applications to mitigate losses in the beekeeping industry and subsequent effects on agriculture (e.g. wild blueberry pollination).

WHAT HAPPENS DURING A DROUGHT?

Drought is a lack of or insufficient rainfall for an extended period that causes water shortages, stream flow reduction, and depletion of groundwater and soil moisture, factors which can cause plant and crop damage. During drought conditions, natural water supply can be limited or non-existent as rivers and ponds dry up, which can impact honey bees in several ways. Plant pollen and nectar availability are both affected by drought. Plants grown under drought-stress conditions have shorter and fewer numbers of inflorescences, and fewer flowers per plant compared to adequately watered plants. Furthermore, drought-stressed plants produce lower quantities of viable pollen grains (Al-Ghzawi, 2009). It has been found that drought not only reduces the abundance of floral units but may also reduce floral species richness (Phillips, 2018). Lack

of adequate high-quality food resources (pollen and nectar) is a major factor in the health and production of bee colonies. Equally important is the availability of water. Water availability has been found to affect nectar in terms of volume and sugar concentration (Phillips, 2018). A consistent, adequate water supply must also be available for bees to cool their hives, control the humidity of the colony, dilute the honey they feed on, produce larvae food and for digestion.

WHAT DOES THIS MEAN FOR THE BEES?

In the Maritimes, drought conditions are becoming more frequent in late summer to early fall when, in ideal conditions, colonies would be building up, storing honey and preparing for winter. Winter bees are produced in August and September, and this cohort requires optimal nutrition to maximize winter survivability. It is during this critical time when beekeepers see nectar flows from important fall flowers such as goldenrod, asters, sunflowers, Joe Pye weed, sedum, canola, buckwheat and clovers, depending on surrounding forage (Pollinator Partnership Canada, 2017). Honey supers are typically employed on producing colonies and at the end of the fall nectar flow, honey supers are typically removed and bees can continue to store reserves in their brood boxes as they prepare for winter. In drought conditions, the late summer/early fall nectar flow may be shorter and less productive, or in extreme cases, non-existent. The lack of nectar and pollen availability not only means less honey available to be harvested by the beekeeper, but it also means less food reserves are being naturally stored by the bees during a vital time when bee colonies are preparing for winter. The immediate effects of drought conditions can also lead to a decline in brood production as less water and



Funders and Contributors:

Bleuets NB Blueberries
New Brunswick Beekeepers Association Inc.

Nova Scotia Beekeepers' Association
Wild Blueberry Producers' Association of Nova Scotia

Prince Edward Island Wild Blueberry Growers Association
PEI Beekeepers' Association

nutrition is available for feeding larvae. Brood rearing is limited to periods when pollen is available and ceases completely in the absence of pollen (Rashad, 1958). A reduction in brood production during this time can mean a lack of 'winter bees' that are needed to carry a colony through the winter months. Inadequate food availability also results in bee health decline and changes in bee behaviour (robbing, aggressive bees, limited foraging activity). The impacts of drought on bee colonies can have a ripple effect and in extreme circumstances lead to considerable losses.

(Figure 1).

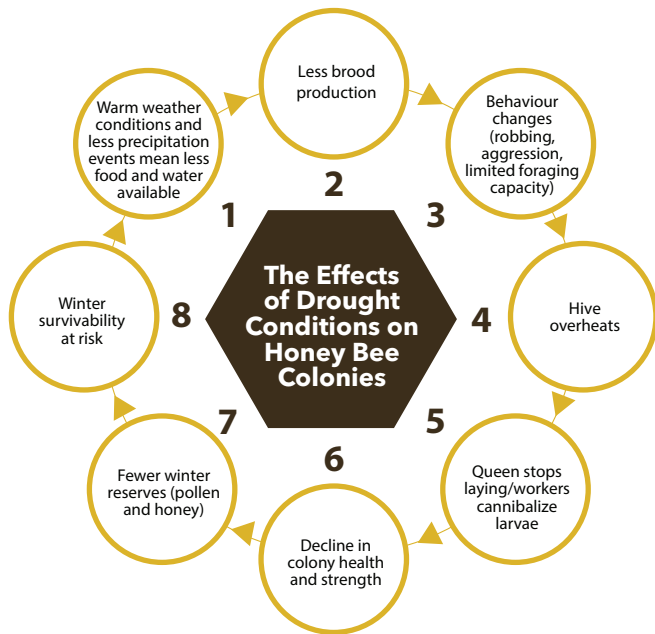


Figure 1: The effects of drought conditions on honey bee colonies.

SIGNS OF DROUGHT

In many cases, beekeepers are often aware of seasonal changes from year to year and can recognize extended dry periods during the beekeeping season. Immediate signs of drought can be very site specific including a reduction or disappearance of a water source, fewer flowering plants, shorter flowering periods, and extended periods of heat. Many beekeepers see the importance of keeping accurate records of the timing of nectar flows, flowering plants, swarming, brood build up and decline, and honey harvest yields. With more frequent years with drought conditions, it is becoming more important than ever to keep records so that signs of drought are easier to recognize and predict (Table 1).

Table 1: Signs of drought in an apiary and in honey bee colonies.

Signs of drought in an apiary	Signs of drought in bee colonies
Water source dries up	Aggressive bees
Fewer flowering plants than normal	Robbing behaviour
Shorter flowering periods	Less foraging activity
Extended periods with no rain	Bees consuming their own resources
Extended periods with high heat	Brood nest decrease in size* Queen reduces or stops laying* Dry larvae No stores in hive Increased number of dead bees Cannibalization of larvae

***During an atypical time of the season.**

Within a bee colony, signs of stress from drought can include aggressive bees as they increase protection of their resources, robbing of weaker colonies, and less foraging activity as fewer resources are available. The bees may also be forced to consume their own stored resources, consuming from their honey supers or brood box stores. With fewer resources, the queen may lay fewer eggs leading to a reduction in the brood nest; when it should typically not be reducing. Cannibalization of larvae by worker bees may also occur and can be observed with bees picking out larvae, holes in brood cappings, or dead larvae present at the hive entrance. Also, dry larvae (larvae without a sufficient pool of food in the cell) is a sign of limited feed available for bees and can be an indication of drought conditions (Figure 2). Nurse bees that feed the developing larvae consume large amounts of pollen, nectar, and water so that their hypopharyngeal glands can produce the jelly that is used to feed the larvae. An absence or reduction in these resources leads to inadequate feed for larvae growth. During extended periods with no water and high heat, colonies may not survive, and beekeepers may see dead or dying bees.

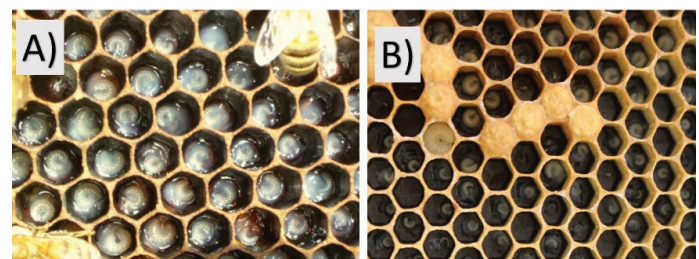


Figure 2: A) Healthy honey bee larvae with plenty of jelly (from <http://scientificbeekeeping.com/fat-bees-part-1/>) vs B) Dry larvae (R. McCallum photo)

WHAT DOES THIS MEAN FOR POLLINATION?

For some beekeepers, a significant portion of their revenue comes from renting hives for pollination services, and blueberry growers depend on the availability of honey bee hives for their pollination needs. Considerable effort is employed to prepare hives for pollination; equalizing and splitting hives, assessing hive strength, securing hives for transport, loading and transporting hives to blueberry fields, among other special management tactics. The added costs of stressed colonies due to drought in the previous year could lead to additional costs for the beekeeper and the blueberry grower. If drought conditions affect overwinter survival of colonies, beekeepers might not be able to meet the pollination demands of blueberry growers. This may lead to additional costs as beekeepers may be forced to split more colonies, purchase additional bees (packages, nucs, full hives) or fail to meet the pollination contracts with the blueberry grower. In addition to this, beekeepers may be hesitant to add stress to their colonies by transporting them to berry fields if they fear drought conditions will also be an issue that season or if they feel their hives are weakened by a previous season of drought. This may force beekeepers to consider increasing their pollination fees.

For blueberry growers, strong hives coming out of winter means pollination needs are met, rental fees remain consistent and the need to import hives from other provinces or find hives from various beekeepers is reduced. Having reliable, consistent pollination contracts and strong hives for pollination is important to blueberry growers as they try to keep their production costs down as well.

WHAT CAN BE DONE IN DROUGHT CONDITIONS?

There are measures beekeepers can take during drought conditions that can lessen the stress to their colonies and help them survive through the season and over the winter. If drought conditions cause water sources to dry up, the apiary can be supplied with water or hives can be relocated to an area with a more reliable water supply. If nectar and pollen sources dwindle, hives can be fed sugar syrup and/or a pollen substitute (although honey supers would need to be removed if sugar syrup is fed). If drought conditions are compromising colony health and result in hives with no reserves built up for the winter, honey supers should be removed earlier than normal and fall feeding started immediately. More volume than usual may need to be added to each hive. Barrel feeding should be done with caution and following provincial recommendations as this may start a feeding frenzy and instigate robbing. Weaker hives could be at risk of being robbed out completely. Monitoring conditions in each apiary is important, as drought conditions can be very site specific. If drought conditions persist at one location, relocating the apiary may be the most effective treatment.

WHAT ARE THE COSTS?

As with any inputs, there are added costs, and beekeepers have to do a cost - benefit analysis for any additional changes in their operations (**Table 2**). Every operation is unique and the costs associated with treatments can be very different for different beekeepers. For example, one beekeeper may have the resources to relocate an apiary without additional substantial costs, whereas another beekeeper may have added expenses such as a loader rental, hiring extra labour, trucking expenses, land rental agreements, etc. If a beekeeper is already equipped for fall feeding, starting those feedings earlier may not be a great expense but if the beekeeper doesn't normally feed in the fall, the added expense of feeders, sugar syrup and the labor associated with feeding could be substantial. However, the benefits of adding inputs to alleviate the stress from drought may far outweigh those costs if the inputs lead to hive survivability. The costs of an extra feeding of sugar syrup and/or pollen substitute may far outweigh the loss of income from a deceased colony. A healthy colony can generate income from pollination rental, honey production (the following year or after the drought conditions cease), queen production, nucleus colonies, and in other ways from wax and propolis sales. A weak or deceased colony can lead to disease susceptibility and spread throughout an apiary and offers no financial benefit to the beekeeper.

Table 2: Cost/benefit of providing inputs during drought conditions.

Drought Treatment	Cost	Benefit
Accurate Record Keeping	Extra labour	Predict hive stress, know your apiary – flowering plants, nectar flow, monitor signs of stress
Add Entrance Reducers	Cost of entrance reducers	Less robbing
Move Apiary	Fuel, loader, truck, labour	Fewer negative effects from drought conditions, healthy colonies, increase hive survivability
Add Water Source	Water transport, monitoring	
Feed Sugar Syrup	Feeders, sugar, labour	
Feed Pollen Substitute	Pollen substitute, labour	
Plant Diverse and Drought Resistant Flowers (Pollinator Partnership Canada, 2017)	Land, seeds	More food availability
= HIVE SURVIVAL		

*During an atypical time of the season.

SOMETHING ELSE TO THINK ABOUT?

The varroa mite, *Varroa destructor*, can cause devastating effects on honey bee health. The good news is that multi-year droughts, as well as successive days with high temperatures, can reduce the mite's reproductive rate (Harris et al., 2003; De Grandi-Hoffman et al., 2016). Monitoring mite load during drought conditions may lead to less costs for mite treatment, but this needs to be explored further.

SUMMARY

Understanding the impact of drought conditions on honey bee colonies is increasingly important for both beekeepers and blueberry growers in the Maritimes. By being aware of the potential impacts and signs of drought conditions, beekeepers can intervene with special management practices to ensure colony health and winter survivability, which in turn leads to a healthy and sustainable pollination capacity of honey bee colonies for the blueberry sector. Special practices may increase in popularity (and necessity) in the future, such as planting forage for bees to target specific times (e.g. late summer or early fall). The cost of intervening during drought conditions is less expensive than losing colonies to drought. For more information, reach out to our ATTTA specialists or visit our website at <https://www.perennia.ca/portfolio-items/honey-bees/>

Funding for the Atlantic Tech Transfer Team for Apiculture (ATTTA) is provided by the provincial governments of New Brunswick, Nova Scotia and Prince Edward Island through the Pan Atlantic Research and Innovation Program through the Canadian Agricultural Partnership, and industry partners including Bleuets NB Blueberries, New Brunswick Beekeepers Association, Nova Scotia Beekeepers Association, Wild Blueberry Producers' Association of Nova Scotia, Prince Edward Island Wild Blueberry Growers Association, and Prince Edward Island Beekeepers Association.

REFERENCES

- Al-Ghzwawi, A. A., Zaitoun, S., Gosheh, H. and Alqudah, A. 2009. Impacts of drought on pollination of *Trigonella moabitica* (Fabaceae) via bee visitations, Archives of Agronomy and Soil Science 55: 683-692.
- De Grandi- Hoffman, G., Ahumada, F., Zazueta, V., Chambers, M., Hidalgo G. and Watkins deJong, E. 2016. Population growth of *Varroa destructor* (Acari: Varroidae) in honey bee colonies is affected by the number of foragers with mites. Experimental and Applied Acarology 69:21-34.
- Harris J.W., Harbo J.R., Villa J.D. and Danka, R.G. 2003. Variable population growth of *Varroa destructor* (Mesostigmata: Varroidae) in colonies of honey bees (Hymenoptera: Apidae) during a 10-year period. Environmental Entomology 32: 1305-131.
- Phillips, Benjamin B., Rosalind F. Shaw, Matthew J. Holland, Ellen L. Fry, Richard D. Bardgett, James M. Bullock, Juliet L. Osborne. 2018. Drought reduces floral resources for pollinators, Glob Change Biol. 24:3226–3235, DOI: 10.1111/gcb.14130
- Pollinator Partnership Canada. 2017. Planting forage for honey bees: a guide for farmers, land managers, and gardeners. [Online]. Available from <https://pollinatorpartnership.ca/assets/generalFiles/Planting-Guide-FINAL-ISBN-June-2017-for-Web-English.pdf>
- Rashad, S. and Parker, R. 1958. Pollen as a limiting factor in brood rearing and honey production during three drought years, 1954, 1955, and 1956. Transactions of the Kansas Academy of Science 61: 237-248.