

Feeding sugar to honey bees

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The supply of white sugar (sucrose) to honey bee colonies can be a valuable management tool for beekeepers. It is used to supplement a shortage of stored honey to prevent starvation of the colony, or to stimulate a colony to artificially promote breeding. Feeding sugar syrup may also be useful in increasing the number of field bees foraging for pollen from the hive. This will enhance their role as pollinators of a range of economic crops. The methods of feeding sugar are diverse and varied. Each has its advantages and disadvantages. White sugar (sucrose) is the preferred sugar to feed to bees. Many other products have the potential to contain substances that could be deleterious to honey bee health. Sugar should not be fed to bee colonies when they have access to a natural nectar flow.

Introduction

When left to their own devices, honey bees collect nectar from flowering plants when in season and store this nectar as honey. In the process of collecting nectar and ripening it to form honey there is a chemical conversion from sucrose (nectar) to fructose and glucose, the main sugars in honey. This is achieved by enzyme activity both naturally occurring in the flower nectar and added by the bees.



Figure 1. Honey comb

The ready availability of nectar stimulates brood rearing and the expansion of the colony population. If only stored honey is available this does not have a stimulating effect on a colony. Rather, the colony behaves in a conservative fashion and minimises brood rearing and colony expansion. These actions by a colony of bees are designed to maximise the colony's survival in a natural system.

A colony of bees requires access to either stored honey or nectar to survive. Without either the colony will die from starvation within days. A cluster of bees without brood will maintain a temperature of 20°C, whereas when a colony is looking after young brood the temperature will be 34-35°C. The colonies requirements for larger volumes of honey/nectar have substantially increased.



Figure 2. Starved adult bees with heads in cells

In early spring it is relatively common for colonies to starve due to the consumption of all stored honey and lack of fresh nectar. This lack of nectar could be due to adverse weather conditions that prohibit bee flight. Active management of honey bee colonies by the provision of sugar will enhance the survival of the colony. By strategic feeding of sugar it is possible to artificially stimulate a colony to breed, expanding its population in anticipation of a major

flowering event in the future, providing a surplus amount of nectar.

Ants can be a big problem when feeding syrup. It is important to prevent any spills and monitor any issues with ants entering the hive to obtain sugar syrup.

Nectar and honey

Nectar is secreted by glands at the base of the flowers, known as nectaries. Field bees collect nectar from blossom in the field. At this stage, the nectar has a high level of sucrose sugar with some laevulose (fructose) and dextrose (glucose) and a high moisture content. There are also traces of other substances such as minerals, vitamins, pigments, aromatic substances, organic acids and nitrogen compounds. Bees convert this nectar into honey in a series of steps. When the nectar is initially collected, it is stored in the honey sac of the returning field bee. An enzyme called invertase is added to the nectar while in the bee's honey sac. Invertase converts the nectar, primarily a sucrose solution, to a mainly laevulose and dextrose solution. The ripening nectar is then stored in the beeswax cells where the moisture content is reduced to 13–18% by the manipulation and fanning of the house bees. When honey is ripe, bees cap the cells with beeswax.

Which sugar?

There are a range of sugar products available to feed to bees including honey, brown sugar, raw sugar, organic sugar, white sugar, waste sugar. The main concern for beekeepers is what effect these supplements have on the colony?

Honey: The first reaction by beekeepers is probably that this is the ideal food for colonies requiring supplementation. The following are the reasons why this is not a desirable food to feed back to colonies.

- Honey has the potential to be the vector of a range of microbial diseases including American foulbrood, European foulbrood, chalkbrood, and nosema disease. American foulbrood disease is fatal to a bee colony. The others are considered serious economic diseases that have the potential, in some cases, to kill the colony.

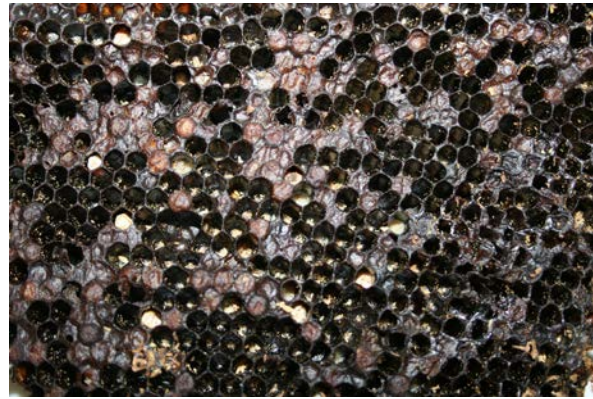


Figure 3. Comb demonstrating advanced infection of AFB

- Nectar or sugar syrup will have a stimulating effect on a colony promoting brood expansion, whereas honey has the opposite effect.
- Feeding honey back to bee colonies in some cases makes the colony more defensive and aggressive.
- Exposing honey in feeders will promote heightened robbing behaviour, putting weak colonies in jeopardy of being invaded by robbing bees from stronger colonies.
- A naturally occurring acid in honey Hydroxymethylfurfural (HMF), increases in concentration the older the honey. The HMF levels also increase faster when honey is exposed to heat. Levels of HMF above 30ppm are considered toxic to bees.
- Bees are twice as attracted to sugar syrup than they are to honey.
- Adult bees live longer when eating sucrose compared to honey.
- Economically it does not make sense to feed honey back to bee colonies when sugar is a fraction of the cost.

Organic sugar: While chemically this is similar to white sugar the specifications show slight differences. Cane sugar or sucrose (Sunshine Sugar-Product Specification April 2009) lists a sucrose level of 99.85% with an ash content of 0.03%, whereas organic raw sugar (Daabon Organic Australia – Technical Data Sheet, May 2006) lists a sucrose level of 99.5% with a ash content of 0.20%. While these specifications suggest very small differences chemically, bees will have less digestive issues with the lower ash levels in the standard cane sugar product. The cost of organic sugar is likely to be substantially higher than refined cane sugar, making it cost prohibitive for beekeepers to consider.

White sugar: We are lead to believe, from a range of information sources, that this is not a desirable food for human consumption, particularly in excess quantities. What we are not told is that the sugar, sucrose is the dominant sugar in the nectar, produced by flowering plants to attract pollinators, including insects, bats, birds and small mammals. White sugar is the supplement that will provide the least risk to bees in the form of digestive complaints, usually manifested as dysentery in bees. White sugar is also economically attractive as a supplement for bees when compared to other sugars and honey.

Raw sugar: This is a sucrose based product with very small amounts of molasses added to give it golden colour. The levels of additives are very small and unlikely to cause many problems to bees. It is likely to be more expensive than 100% white refined sugar (sucrose).

Brown sugar: Although essentially a sucrose product, brown sugar is produced by the addition of molasses to refined white sugar. Brown sugar may contain up to 10% molasses.

Molasses: This is a by-product of the refining of sugar cane into sugar. Although it is used as a stock feed, it is unsuitable to feed to bees.

Waste sugar: At times beekeepers have been able to obtain waste sugar from sweet factories or food manufacturers. The problem with waste sugar is that additives in the sugar may be toxic to your bees. Salt and starch are poisonous to bees in increasing concentrations. It is unadvisable to feed waste sugar to bees unless you are aware of what else may be included in the waste sugar.

Role in bee management

Sugar feeding can be used as a supplement in several beekeeping activities including:

- Providing food for bee colonies during shortages of honey or nectar i.e. winter or drought periods;
- Stimulating colonies to increase the amount of brood being reared. This will ultimately increase the population for a targeted flowering event in the future;
- Stimulating a colony to collect pollen preferentially to nectar to enhance the pollination of certain crops;
- Used extensively when rearing queen bees to ensure the best possible nutritional conditions and stimulate brood food glands in young nurse bees.

Amounts to feed

White cane sugar probably remains the safest and most reliable nectar substitute for honey bees. The concentration and quantity are equally important. For colony stimulation in spring or when queen rearing, feed small quantities (1–2 L) every few days of a 1:1 concentration of sugar and water by volume. To provide stores for winter, a colony should be fed in the autumn with quantities of 5 to 10 litres on a regular basis (weekly) until the colony has sufficient processed sugar stored.

If the bees do not consume all the syrup within a few days there is an increasing threat of yeast growth in the syrup mixture within the feeders. Yeast at rising concentrations can be very toxic to bees and lead to an early death of the adult bees. It is important to keep and mix syrup in clean sterile containers. The feeders should be thoroughly cleaned and sterilised between feeds of sugar syrup. Any syrup with evidence of fermentation or which has a sour taste should be discarded and not fed to bees. Mix enough syrup for immediate use only.

For winter stores a ratio of 2 parts sugar to 1 part water is used to provide a thick syrup. Do not feed a sugar syrup mix thinner than a 1:1 ratio as bees have to do too much work to retrieve the sugar.

Sugar concentration

Dry sugar is the best form of sugar without stimulating the colony to any significant extent. Thick syrup (67%) is less stimulative than thinner syrup (50%), thus the beekeeper must decide what the aim is, as this will influence the preparation of the sugar.

How sugar is fed to bees will have a major impact on the type of response by the colony. A large amount of syrup fed all at once may have a reducing stimulus effect, compared to slow release of the same amount of syrup over many days. Thus the type of feeder, i.e., open or slow release, of the same volume of syrup will impact on the colony's behaviour.

Sources of sugar

Sugar syrup can be purchased in bulk in 200 litre drums or IBC's. This syrup is usually 67% in concentration and available from outlets in capital cities. Dry sugar can be purchased in 20 kg bags individually or by the pallet. If you only require a few litres then your local supermarket will do.

Remember to price the product as some sources of sugar can be significantly more expensive, particularly when you are feeding large quantities

of sugar to bees. If you do stock pile dry sugar for later use then it is very important to store it in a mouse proof container and away from direct moisture. It is best to only buy enough sugar syrup for your immediate needs.

Sugar feeders

There are a number of methods of feeding sugar to a colony. Sugar fed in a dry form can be used in an emergency. The sugar is heaped, perhaps ½ kg to 1 kg, on the inner mat of a hive. The amount depends on the strength of the colony, as it does in all supplementary feeding situations. This method has been used to feed bees through winter when the colony is running short of stored honey. Feeding liquids in the form of sugar syrup could be detrimental for the colony as it may promote the circumstances by which nosema disease proliferates. Minimising hive manipulation during the cooler months reduces the incidence of nosema disease.



Figure 4. Dry sugar provided on inner mat under lid

The amount of honey stored in the hive may be determined by tilting the bee hive forward. If the hive is excessively light, lift the lid and place the dry sugar on the inner mat. Check within a week to determine whether the colony requires further sugar supplies. The disadvantage of this method is the dry sugar can be scattered around the hive and lost to the bees.

Feeding sugar in syrup form is the most popular and probably most effective method. There are numerous different types of sugar syrup feeders. The type of feeder used will depend on what materials the beekeeper has available and possibly what types of commercial feeders are currently on the market.

Bottom board feeder

A bottom board feeder or 'Alexander' feeder replaces part of the bottom board. The bottom board is slid forward and a tray containing sugar syrup is replaced in the gap provided. This feeder

is dependent on purpose-built feeders and loose bottom boards. This method is not widely used and only small quantities of sugar syrup can be supplied at each feeding.

Boardman feeder

A jar placed on a special feeding frame at the entrance of a hive has been popular, but has some major restrictions. These containers are often referred to as Boardman feeders. They are only useful for very small quantities of sugar syrup in a situation where stimulation of a colony is required. They should be refilled each day if empty. These feeders may encourage robbing due to their location at the hive entrance, although this has not been my personal experience.

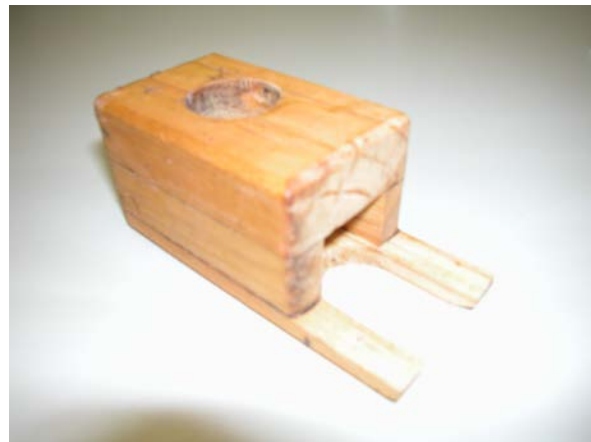


Figure 5. Feeder block to hold bottle feeder



Figure 6. Bottle feeder in place, providing sugar syrup to nucleus colony

Division board feeder

Division board feeders are purpose-made frames that will hold syrup. They may hold only one to three litres. This may be useful in a queen rearing apiary where stimulation of the hive is desired. Unfortunately, the colony is exposed for the frame feeder to be filled; this may be very harmful to a colony of bees during cool or cold weather. An existing frame must be removed to place the division board feeder into the hive. Timber shavings, a wire screen or twigs should be placed in the feeder to prevent bees being drowned while taking up the sugar syrup.

If making your own frame feeders using masonite, place the rough surface inwards to reduce bees drowning.



Figure 6. Pouring sugar syrup into frame feeder

Top feeder

Top feeders come in a variety of designs and sizes and are probably the main method of feeding quantities of sugar syrup to a hive. Various size buckets or jars with small holes in the lids are inverted over the top frames or a hole in the lid of a hive. An empty hive body can be placed on the hive and jars or buckets placed in this hive body. The lid of the hive is placed on the hive over the feeders. If syrup feeding is conducted on a regular basis some beekeepers cut a 5–10 cm diameter hole in the middle of a lid to enable easier feeding of colonies. Specially made top box feeders can also be constructed to feed larger quantities of syrup to bees. Syrup can also be placed in various sized plastic bags, punctured with a number of small nail holes, and placed on the top bars. This is also a useful method for feeding syrup on an occasional basis.

Yet another method is to place a 10 litre bucket in an empty super on top of the hive. Place shade cloth (or similar material) in the bucket and fill up bucket with syrup.



Figure 7. Tray feeder with floating platform to prevent bees from drowning



Figure 8. Hole in lid of hive to place bucket with sugar syrup



Figure 9. Bucket feeder inverted over hole in hive lid



Figure 10. Bucket full of sugar syrup with close fitting lid. The middle has several small holes

Bulk feeding

Open feeding in bulk containers has been used very successfully. The field bees require warm weather to be able to fly to the feeder. The open feeder should be placed as near to the hives as possible to encourage them to take up most of

the syrup and not other bees in close proximity. The colonies with larger populations are likely to take up more syrup than smaller populated colonies.

Mix up enough syrup for the equivalent of each hive in the apiary to consume one or two litres. Place an open clean vessel in the apiary. Pour the syrup into the container and place a layer of straw over the top of the syrup. This prevents the bees from drowning. If livestock (cattle, sheep) are present, then cover the vessel with a wire grid preventing the animals from drinking the syrup. There have been cases where cows and goats have died as a result of drinking sugar syrup.



Figure 11. Open sugar syrup feeder, the straw is to prevent bees drowning

If there is any chance of rain, then cover the feeder. Light rain particularly may sit on top of the syrup and make the mix less attractive to bees. If all goes well, the feeder will be emptied within a day or two. Sometimes the bees take a day to figure out that the syrup is available. To speed up the communication spray a small amount of syrup at the entrance of each hive in the apiary.

Some beekeepers have suggested that this practice makes bees aggressive. I have found the complete opposite with bees becoming very quiet and easier to handle. There is no evidence of open feeders causing any increase in pest or disease issues within the apiary or individual colonies.

Bulk or open feeding is an excellent means of feeding an entire apiary without the need to enter or interfere with individual hives. There is also the added benefit of not having the extra expense of individual feeders for each hive.

Sugar contamination of honey

This is an extremely important issue when considering feeding bee colonies sugar syrup. The evidence suggests that honey bee colonies fed one or two litres of sugar syrup at a time are

likely to consume all this liquid sugar and not store any of the sugar for any length of time. The use of small amounts of sugar syrup to stimulate bees on pollination jobs, for use in queen rearing systems, or to stimulate the colony in early spring, should not pose any significant risk as far as sugar syrup being stored and at some future date extracted.

Feeding larger quantities of sugar syrup does pose a risk of the sugar syrup being stored by the bees and at some future date being extracted by the beekeeper. Feeding large quantities of sugar syrup may occur in autumn in preparation for winter or during periods of severe drought. In most cases the bees will consume the bulk of this stored sugar and the risk of extracting stored fed sugar will be minimal. The first extraction after large quantities of syrup have been fed to bees should be identified in the paper work sent to the honey buyer/packer company. This first extraction could be many months after the sugar syrup has been fed to the bees.

While not feeding bees any sugar would be ideal, the occasional or seasonal use of this management process can be a lifesaver for the bees and can significantly enhance a colony's performance.

Conclusion

The strategic use of sugar as a supplement provided to honey bees is a proven management tool and will enhance productivity in many circumstances. Due care should be considered as to which supplementary products are used, how much is fed to bees and how this is done. Sugar, if used incorrectly, can be detrimental to bees, particularly due to yeast contamination. White cane sugar (sucrose) is the safest, most cost effective product to feed to honey bees.

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