Basic Beekeeping Course

Session 5 – Syrup

The Inside Story of Feeding Sugar to Bees

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The practice of feeding sugar (either dry or as a syrup) is becoming more and more popular with beekeepers. This trend partially rejects the increasing price paid for honey, also the need for extra winter stores due to the paucity of late autumn and early spring nectar sources. Many beekeepers pour the sugar into the hive, close the lid, then hope for the best. Sometimes when they come back the bees have converted all the sugar into ripened stores. In other hives, maybe an adjacent one, the sugar (either dry or in a syrup) is still in the feeders and could be in various stages of fermentation. It is a strange fact that two hives can appear equal in bee strength, brood and stores, yet one will readily store sugar while the other will not, especially if dry sugar is fed. I wonder if anyone has noticed any correlation between the productivity of a hive and the rate at which it stores sugar? In other words does a hive that produced a good crop of honey, relative to others in the apiary, also store sugar more readily?

What does the bee do with the sugar?

Bees must invert or "digest" the sucrose -molecules, before they can assimilate them, as well as reduce the water content. In the case of dry sugar the bees add a great deal of water to the crystal, more in fact than to concentrated sugar syrups or honey. This will mean the bees have to make extra foraging flights to collect water. According to Simpson, food containing more than 50 per cent or more sugar is diluted first before being ripened. The enzymes (particularly invertase) which are necessary for reducing the sucrose molecules are produced in the hypopharyngeal glands of the adult bees. These are the same glands that first produce royal jelly for feeding larvae and the queen, and are most active in bees aged 5-13 days. From 17 days.onwards during the summer, the glands rapidly shrink in size, and cease producing royal jelly, but the amount and activity of the enzymes secreted is increased. Enzyme production, naturally enough, reaches a peak after three weeks when the worker bees begin foraging. In the winter time bees of all ages have large glands rich in invertase.

Effect of disease on the hypopharyngeal glands

Nosema disease is known to affect the glands of bees and reduce the amount of royal jelly produced. Nosema also affects the levels of protein and amino acids in the blood but it doesn't influence the levels of blood sugar at all.

The effect of enzyme production on honey yields

Some recent research work carried out in Russia suggests that the honey production of a hive could be related to the efficiency of enzyme production by the bees and that this efficiency varied, from hive to hive. Naturally the strongest hives, with bees producing most inverting enzymes also produced the most honey.

Storage of sugars in the body

Bees have the ability to store surplus protein in their fat bodies and also in their Mood. However, they do not have any storage organs as such, for sugars. Rather the sugars remain free in the blood and the levels are not regulated as in mammals, but fluctuate markedly according to the diet and activity of the bee. Thus, when a bee first emerges or when it is resting on the comb it has very little sugar in its blood. However, when it is out foraging, blood-sugar levels become very high.

Physiological demands on the bees

Converting sugar into honey and storing it is a very exhausting process, in terms of energy used by the bees. The bees must first produce the enzymes, and secrete them, they must suck up the syrup and invert it, they need to keep thehive temperature high to evaporate excess moisture from the syrup, as well as secrete and manipulate the wax to store the honey in. Let's look at some of the processes involved and see how we can help the bees to be more efficient. In all these considerations timing is reasonably important. In most areas April-early May would be suitable for feeding sugar to winter the bees on. *(NEW ZEALAND WINTER!!!)*

(a) Inverting the sugar
We want to get the sugar. inverted and ripened while the maximum number of older bees with active glands are in the hive. These bees are mostly expendable and will not survive long into the winter anyway. Ideally we want a balance between having enough older bees but not too many to consume excess food.

(b) Heating the hive

Bees generate a lot of heat from the sugars they eat. Of this heat Wedmore calculated that 60-70 per cent is used to heat the bees, 20 per cent is used to evaporate water, and 10 per cent is used to heat the air, so a significant amount is used solely to evaporate water.

The energy required for ripening large quantities' of nectar is appreciable; for instance Ribbands calculated that the elimination of each pound of surplus water involved the wastage of 4-5 ounces of sugar. This is about 25 per cent and approximates Wedmore's figure of 20 per cent. Further the actual consumption of honey also releases water as the "water of combustion" plus the 17-18 per cent water naturally in honey, and this too demands energy to get rid of it. This extra water may be as great as one-half to two-thirds of a pound for every pound of honey consumed. Some of this water is lost by evaporation but the great majority is stored temporarily in the rectum then disposed of during cleansing flights. Again the bees should have ample opportunity for flying during the period in which they are ripening sugar stores.

(d) Wax production

One researcher found that one pound of wax can be built into 35000 cells which would hold 22 pound of honey. Other workers have found that it takes somewhere between 6-10 pounds of honey to make one pound of wax. So a significant amount of our original sugar stores are also going to be used up in producing the wax as well as maintaining a high cluster temperature needed to manipulate the wax scales into comb.

(e) Case study

Let's take an example and see just how much of our original sugar we can .expect to be converted into sealed stores.
Let's feed 4 gallons of 2:1 or 62 per cent white sugar syrup. This will contain 32 pounds of sugar at the rate of 16 pound to the gallon and should weigh in the vicinity of 52 pounds assuming our ripened stores will contain 18 per cent moisture we have to lose 20 per cent water or about 10.4 pounds of water. Now this represents an elimination cost of nearly 3 pounds of sugar, if 4-5 ounces of sugar, are lost per pound of excess water. This sugar itself when consumed by the bees will also release excess water of combustion that will require energy to eliminate. However, that is getting a bit complicated. Now the bees are going to use something like 5-9 pounds of honey at sugar to build enough wax to hold the syrup, although this figure could fluctuate depending on how drawn out the combs were. But from our original 52 pounds of syrup we have lost or used up 10.5 pounds of water, and say 11 pounds of sugar to eliminate the water and produce the wax. This leaves us with about 30.5 pounds of ripened stores. As a rough rule of thumb in estimating stores produced from syrup. The final weight of ripened stores in the comb is slightly less than the weight of dry sugar in the original syrup - in our case we could expect about 30 pounds of ripened stores from 32 pounds of sugar.

Recommendations

Don't leave your sugar feeding until too late in the autumn.

Feed while:

- There are plenty of older expendable bees with active glands still present.
- It is not too cold to secrete wax.
- It is not too cold or damp for the efficient evaporation of moisture out of the hive.
- There are still some natural honey stores in the hive.

And remember-

"BEES DO NOT FREEZE TO DEATH - THEY STARVE TO DEATH".

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