ATTTA
Atlantic Tech Transfer Team
for Apiculture

A Closer Look at Splitting and Nucleus vs Packages Buildup

Atlantic Tech Transfer Team for Apiculture (ATTTA)
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Splitting colonies is an essential practice in any beekeeping operation to achieve sustainability, but can be particularly unique in the Maritimes due to the timing of wild blueberry pollination and seasonal honey flows. This fact sheet takes a closer look at splitting honey bee hives in this region, and also discusses the buildup of different types and styles of splits.

What is splitting?

'Splitting' is a general term often used to describe multiple activities in the bee yard. For example, 'splitting' can refer to splitting a strong honey bee colony into multiple smaller colonies, and it can also refer to pulling a smaller colony, called a 'nucleus colony' (also called 'nuc'), from a larger colony.

Why do we split colonies?

Colonies are split to make up for winter losses, to increase hive numbers, to make nucleus colonies for sale, to create mini nucs for queen production, and to prevent swarming. Splitting existing colonies to expand your apiary costs relatively little compared to buying bees in the form of packages, nucs, or full colonies.

When is splitting conducted in the Maritimes?

The easy answer is once hives are large enough, and this can vary among locations in the Maritimes and among hives in a bee yard. In the Maritimes, splitting can sometimes occur in May before blueberry pollination, but more commonly after blueberry pollination, until early August. Many beekeepers from Nova Scotia report that about a third to half of their colonies are strong enough to split in May before blueberry pollination. This is a good rule of thumb to follow, but can vary from year to year depending on the strength of the colonies going into and coming out of the winter, the severity of the winter, and the weather in the spring. What is possible in one region of the Maritimes may not be possible in other regions. Generally, there should be six to ten brood frames in the parent colony before it can be split, as there needs to be lots of brood and honey left in both hives.

It's important to keep in mind that there are many correct and effective ways to split colonies. With a better understanding of biology and good hive management, beekeepers can use their resources effectively to maximize the number of new colonies produced. This can help offset overwinter losses, or boost revenue streams through the sale of additional colonies. There still seems to be a high demand for nucs in our region from the continuing serge of new beekeepers, which can be a great additional revenue stream for beekeepers to complement pollination and honey production.

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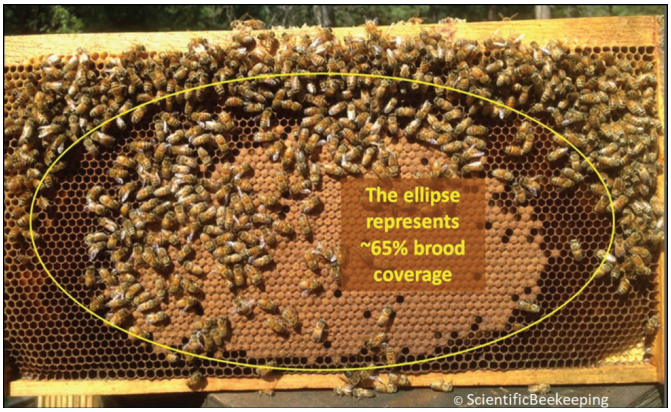
How do we split?

Typically only strong colonies should be used for splitting. Alternatively, some beekeepers choose to split unproductive colonies after blueberry pollination that are likely not going to produce a honey crop that season. In this case, the queen from the unproductive colony is usually killed, and the colony is split up to make multiple (2-5) new hives which are given mated queens or queen cells.



Splitting strong, productive colonies just before or during a nectar flow comes at a cost of reduced honey production. By splitting unproductive colonies, you can increase the number of hives in your operation without losing honey production.

Generally, the process of splitting a hive is to take resources, in the form of bees, brood and food, from a parent colony, and to use that to start one or more new colonies. The frames of bees, brood and food are placed in smaller boxes, typically a nuc box or a single deep hive, depending on the size of the split. Nucs are comprised of three to five frames of bees in various stages, as well as food stores in a smaller hive box. A nuc can be overwintered in a nuc box or moved to a larger standard box, depending on when in the season it is formed and how it develops. A mated queen, virgin queen, or queen cell can be added to the split or nuc, or the bees can be allowed to raise their own queen provided the split was given a frame with eggs. Typically the original queen remains with the parent hive and the new queen or queen cell is given to the new colony.

Splits are commonly moved from the original location to a new location more than 5km away to avoid drift of forager bees back to the parent colony. Splitting colonies is best on sunny, warm days as the forager bees will be busy and away from the hive. However, a few extra shakes of bees into the split may be necessary to keep the brood warm. For more information on caring for splits once they are made, see ATTTA's Spring Management Guide: http://www.perennia.ca/wp-content/uploads/2018/03/Spring-Management-Guide_2018.pdf

In addition to a background in splitting, this fact sheet examines recent work done by Randy Oliver on nucleus colonies split in different configurations, and bee package buildup (http://scientificbeekeeping.com/modeling-nuc-buildup/). Randy Oliver has developed theoretical models to illustrate colony growth under different starting conditions.

Randy Oliver's models were developed with the following assumptions:

- Results are theoretical based on projected growth under best possible conditions
- 2000 bees covers 1 frame
- 1 frame of brood = 65% coverage with brood of all ages
- Not limited by nectar or pollen
- All frames added are drawn comb

We must remember that these models were based off the best possible conditions and a number of things can slow down and impact colony growth like weather, access to drawn comb, poor queens etc. We suggest these models are most appropriate for splitting that occurs post-pollination (end of June, early July) in our region.

Don't overestimate brood frame coverage

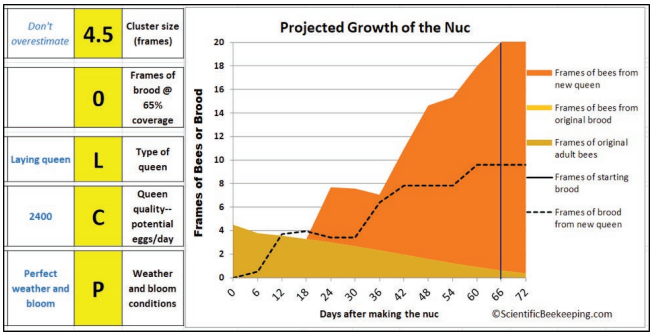
We often have a habit of making our splits and selecting frames with brood on them, and counting any amount of brood as 'one frame of brood'. However, the amount of brood coverage matters, and can make a huge difference to how that split will build up. Be honest in brood coverage evaluations.

Looking at build up

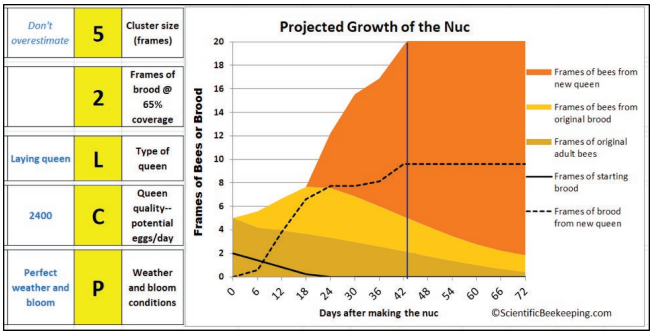
First, let's explore the buildup of package bees. The graphic below examines growth of a 2 lb package.

In our region, packages typically arrive in early April. Generally beekeepers purchase 1kg packages, which is 2.2 pounds. By following the model developed by Randy Oliver below, if we assume packages are received and hived by April 10, it would take at least 38 days (May 18) to reach the pollination standard of 8 frames. This works out to be just before hives are sent to pollination. It is also important to note that about 35 or 36 days after being hived, the package of bees starts and continues exponential growth and will reach 20 frames of bees after 66 days. Note that this exponential growth period will be during blueberry pollination, at a time when beekeepers typically send their hives off and won't see them for 3-4 weeks until after blueberry pollination is over. Therefore, it is a good practice to send bees with enough space in the form of extra supers to prevent swarming in blueberry fields, or add supers shortly after they return from pollination.

While packages are a great tool for experienced beekeepers involved in blueberry pollination (e.g. to make up for winter losses or to meet pollination demand), packages can be challenging for new beekeepers. Typically new beekeepers are limited by not having much, if any, drawn comb or frames of honey. Although these are not necessary for hiving package bees, they are very useful and advantageous to have. Instead, we would recommend new beekeepers begin with nucs, as these are small but already functioning colonies that come with drawn comb. They are purchased a bit later in the season (usually May or June).



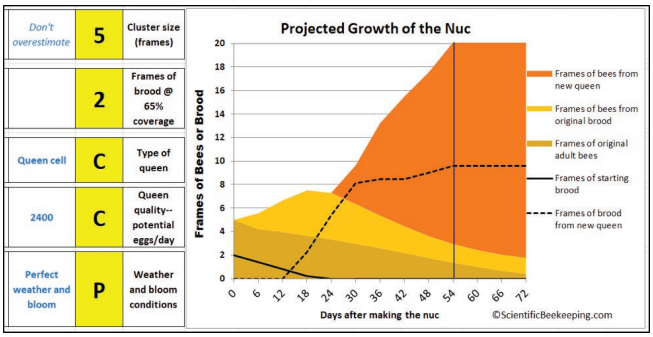
The next graphic below examines growth of a 5 frame nuc with a laying queen. In this 5 frame nuc, the model was run with 5 frames of bees, and 2 good frames of brood.



Five frame nuc with 2 frames of brood and layig queen by Randy Oliver

Notice that in a 5 frame nuc with a laying queen, the colony reaches 20 frame strength at 42 days, which is 24 days sooner than a package. On a practical level, if a beekeeper purchased a nuc on May 15th, it would be a 20 frame colony by the 26th of June. We must continue to stress that the growth in this model is based off a number of assumptions, one of which is access to drawn comb. Thus, a new beekeeper with a newly purchased nuc is likely to only have foundation frames to put in the hive with their nuc. Therefore, even if you feed your nuc to help them draw out comb, which is recommended, it will still take considerably longer for a nuc to build up with foundation frames.

The next graphic displays a 5 frame nuc with 2 frames of brood, with a ripe queen cell.

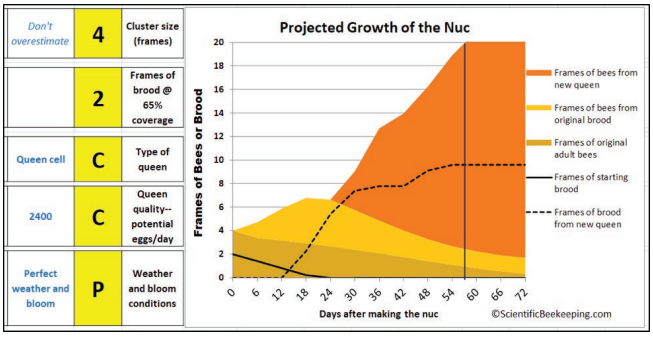


Five frame nuc with 2 frames of brood and ripe queen cell by Randy Oliver

The only difference between this nuc and the previous one is using a ripe queen cell instead of a laying queen. When a ripe queen cell is placed in a 5 frame nuc, the colony reaches 20 frame strength only 12 days later (55 days total) than with a laying queen. By using a queen cell, beekeepers could potentially lower their input costs and still control genetics (as opposed to a walkaway split). Imported queens can be costly at approximately $40 per queen, may not be ideally suited to our unique maritime climate, and there may be issues with queen quality. We would recommend buying locally mated queens or queen cells to not only obtain queen genetics that are tried and proven, and thrive under our local conditions, but also to support your local queen producers. Alternatively, you could try your hand at raising your own queens. There isn't anything more fulfilling and rewarding in beekeeping than making your own queens! If you do make your own queen cells, sell or trade cells with other beekeepers to increase favorable genetics in your beekeeping operation (keeping in mind you must be inspected to sell or trade bees in Nova Scotia).

For a practical application, if a beekeeper was to make a 5 frame nuc on July 1st and introduce a queen cell, by the third week of August the colony would reach 20 frames of bees. However, we must remember that the model assumes perfect conditions and that we don't necessarily need 20 frames of bees for the colony to successfully overwinter. We recommend that colonies should be at least 7 or 8 frames (approximately 7 seams) to have a good chance to overwinter, although many beekeepers can and do winter colonies much smaller than this in the Maritimes. According to this model, under perfect conditions it takes just shy of 30 days for a 5 frame nuc to reach approximately 8 frames of bees. Generally in the Maritimes, we would like to see colonies in good shape to winter by the 1st of September, although this can vary from year to year based on the weather. If we look at the amount of time it takes to reach 8 frames of bees and work backwards from September 1st, you can see that based off of this model, the beginning of August would be the latest you should make nucs for them to reach 8 frames of bees by early September. This is why it is recommended not to split colonies any later than the beginning of August in the Maritimes. However, skilled beekeepers who are overwintering nucs can successfully make nucs in August, with the sole purpose of overwintering those colonies as nucs, not full colonies. When making splits late in the season, there would be an advantage of about 12 days by introducing a laying queen instead of a ripe queen cell.

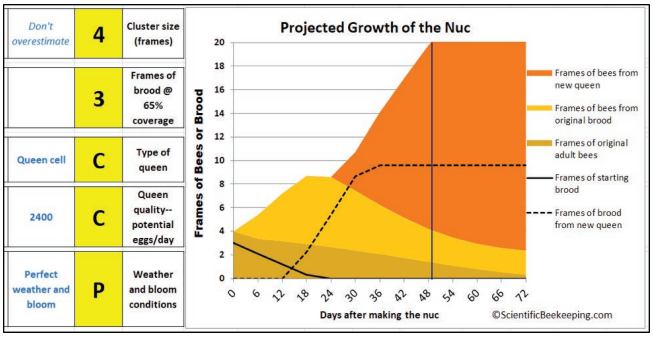
The next graphic demonstrates the growth of a 4 frame nuc with a ripe queen cell.



Four frame nuc with two frames of brood and ripe queen cell by Randy Oliver

When a ripe queen cell is placed in a 4 frame nuc containing 2 frames of brood, the colony reaches 20 frames only 3 days later (58 days total) than with a five frame nuc with 2 frames of brood and a ripe queen cell. You can see when you keep the same amount of brood in a nuc and just reduce the amount of bees that you put in a nuc, it really doesn't make a big difference at all! This is an interesting model, since we all like to add that extra shake or two of bees into our nucs and splits, but according to this model, that extra shake may not be as necessary as we like to believe (keeping in mind that there still needs to be enough bees in the hive to take care of the brood). This is also interesting for new beekeepers purchasing nucs. Some beekeepers in the Maritimes sell 4 frame nucs, while some beekeepers sell 5 frame nucs. A common thought of new beekeepers is that bigger is better, but that isn't always true. On the basis of frames of bees, there appears to be no benefit to buying a 5 frame nuc over a 4 frame nuc, as long as the amount of brood in the nuc is the same. However, this is not the case when the number of brood frames changes.

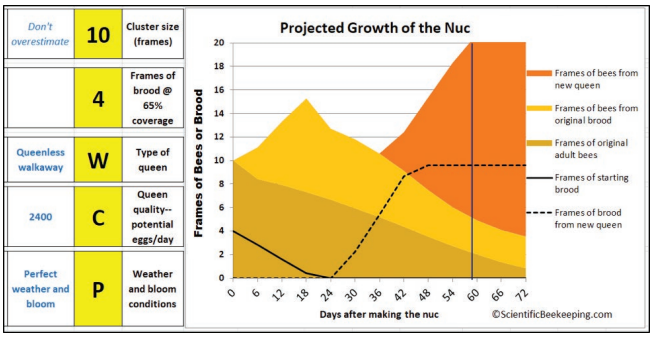
Next, a 4 frame nuc with 3 frames of brood and a queen cell is compared.



Four frame nuc with three frames of brood and ripe queen cell by Randy Oliver

This is where things get interesting- a 4 frame nuc with 3 brood frames reaches 20 frames 9 days earlier (49 days total) than a 4 frame nuc with 2 brood frames (49 days total). By adding an extra frame of brood to a nuc, you can expect your hive to grow faster, and reach maximum strength up to 9 or 10 days earlier. Therefore, when making a nuc, if the parent colony can spare losing an extra frame of brood, it would be an advantage to add it to your nuc. This is especially true if you were making nucs later in July or early August.

Finally, the growth of a walkaway split is examined.



Walkaway split with four frames of brood by Randy Oliver

Walkaway splits are about the easiest splits that you can make, and they can be very successful. They don't require a lot of time for the beekeeper to make them, and typically these larger units are able to take care of themselves with little intervention by the beekeeper. When nucs are made, beekeepers typically would, and should, feed these colonies to promote growth. Feeding is not something that typically needs to be done with a walkaway split. However, easier does not always mean better, and here is why:

In a walkaway split, the colony reaches 20 frames just shy of 60 days. However, if you remember back to previous models, this is actually 5-6 days later than a 5 frame nuc with a ripe queen cell, or 15-16 days later than a 5 frame nuc with a laying queen. Also think back to the formulas for the nucs, especially a nuc with 5 frames of bees and 2 frames of brood with a ripe queen cell verses a walkaway split with 10 frames of bees and 4 frames of brood. Logically, with this formula you can make two – 5 frame nucs, for the same resources (bees and brood) as it takes to make one walkaway split, and these two nucs will reach full strength a little quicker than the walkaway will. Although there is an initial spike in population from the walkaway split, since it takes about 24 days for the new queen to develop, hatch, mate and start laying, there is a decline in population until brood from that queen hatches. By examining other strength endpoints, such as the time it takes to reach 12 frames of bees, the nucs with ripe queen cells or laying queens still reach these endpoints faster. Again, although there is an initial spike in population with a walkaway split, the population will decrease over time until brood from the new queen hatches. It is also important to mention that although walkaway splits are easy and can work well, they are not a good way to control genetics in a beekeeping operation. For example, by introducing queen cells or mated queens that you produced from your own beekeeping operation or that you purchased locally, you are improving the genetics of your beekeeping operation. By making a classic walkaway split, you are generally continuing to "recycle" the same genetics without making your stock any better. Because you would make walkaway splits with your good, and likely some of your "so-so" hives, the genetics of the daughter queen from the walk away split from a "so-so" hive, will likely continue to be "so-so", and you aren't really making your operation any better. Sure, the queen is only half of the picture and drones obviously play a key role in the genetics of the colony, but it is much more difficult to control drone genetics and mating queen. The queen genetics are much easier to control;by adding queen cells or mated queens to splits of similar size to walkaway splits, you can expect the development time of the colony to be earlier, although there is no model to show this. Making a walkaway style split early May and adding a mated queen would create a colony that would be suitable for pollination and meet pollination standard by the end of May.

So- what does this all mean?

When a laying queen is added to a nuc, an extra 12 days of growth can be achieved compared to a ripe queen cell being added.

There doesn't seem to be a major difference between a 4 and 5 frame nuc with 2 frames of brood, but when an extra frame of brood is added to a nuc, production can be boosted by 10 days.

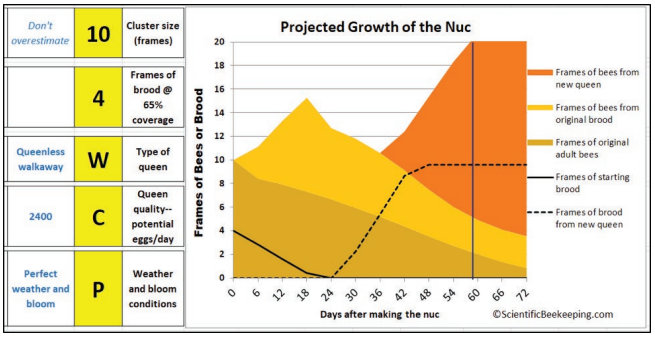
Walkaway splits are the least productive use of resources (e.g. brood frames) but if modified by adding a laying queen, can make colonies that are suitable for blueberry pollination. For example, by adding ripe queen cells or a laying queen to a nuc, you can make two, 5 frame nucs with the same amount of resources, and those nucs will reach 20 frames 5-15 days earlier than a walkaway split.

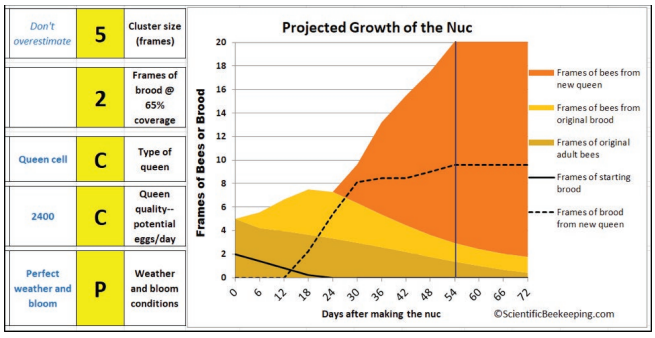
A Closer Look

The figure on the left below is the walkaway split graphic from before. The figure on the right is a 5 frame nuc with a queen cell. Notice the difference in development time to 10 frame strength, as well as to 20 frame strength. Next, let's consider the economics of walkaway splits versus making splits with queen cells or laying queens:

If you consider splitting a full, 20 frame double deep colony, for the same use of resource, you can make one walkaway split, or two 5 frame nucs, and still have the same strength parent hive left over.

Making a split with a queen cell ($10-20) or mated queen ($50-80) is more expensive initially than a walkaway split, but for the same allocation of resources, beekeepers can gain one extra hive per split.





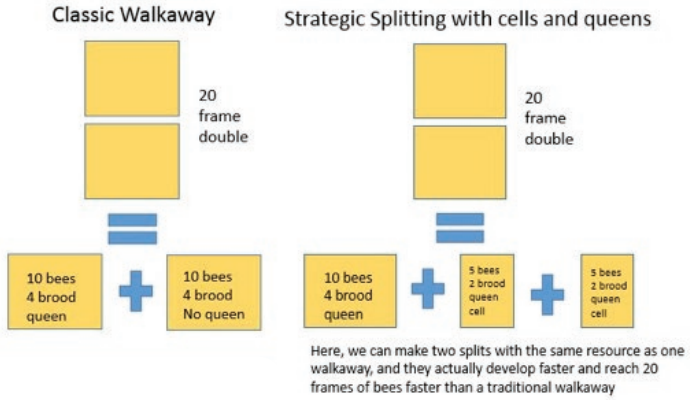
This additional hive can help recover from winter losses, build up hive numbers, send an additional hive to pollination, sell a colony, or generate additional honey production.

So- how do we split strategically?

There is no major benefit to making a split with four or five frames, but if there are extra brood frames to spare, an additional frame of brood will contribute to faster build up.

Walkaway splits are easier initially, but may not be the most strategic use of resources. Factors to consider include ability to source queen cells and/or mated queens, amount of resources available (e.g. brood frames).

Using laying queens allow the colony to build quickly, but they can be costly. Alternatively, beekeepers could begin grafting their own queen cells (see ATTTA's cell builder cheat sheet here: ***http://www.perennia.ca/wp-content/uploads/2018/03/Queen-Rearing-Cheat-Sheet-Finalb.pdf).***



Here, we can make two splits with the same resource as one walkaway, and they actually develop faster and reach 20 frames of bees faster than a traditional walkaway

References:

Oliver, R. 2018. Modeling nuc buildup. [Online]. Available from ***http://scientificbeekeeping.com/modeling-nuc-buildup/*** [accessed 10 December 2018].

Recommended Resources:

The Beekeeper's Handbook by Diana Sammataro and Alphonse Avitabile

ATTTA Spring Management Guide: ***http://www.perennia.ca/wp-content/uploads/2018/03/Spring-Management-Guide_2018.pdf***

University of Guelph Honey Bee Research Centre (Splits): ***https://www.youtube.com/watch?time_continue=2&v=FwGWN0AyoFg***

University of Guelph Honey Bee Research Centre (Double Nucleus Colonies 1): ***https://www.youtube.com/watch?v=-zy2JeBj_i0&list=PLhUDH9LkxRdOv9UDyzLHECULI5p1XnXhC***

University of Guelph Honey Bee Research Centre (Double Nucleus Colonies 2): ***https://www.youtube.com/watch?v=b9Hn1wvKb54***

As always, a beekeeping mentor!

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ATTTA Webpage: ***http://www.perennia.ca/portfolio-items/honey-bees/***