TECHNICAL SUMMARY

UNDERSTANDING THE **VALUE OF POLLEN COUNTING**

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Pollen count is a test that identifies what pollen types are present in a honey sample and how much pollen in total is in a sample. This test can be used to help understand where bees have been foraging to predict what nectar has been used in making the honey. Honey is made from nectar, not pollen, so there are a few limitations of this test that must be factored in when using test results to identify the floral type of a honey.

Background to pollen counting

Identification of pollen in honey, or melissopalynology, has been used in New Zealand to identify the floral source of honey since the early 1900s (Waters, 1915). Prior to this, there were limited ways to identify which plant a honey had been made from and classification largely relied on qualities such as colour, smell and taste. Today, pollen counting is frequently used in New Zealand and abroad as a quality indicator and authenticity marker to ensure correct labelling and product quality at export (Molan, 1998).

Pollen counting continues to be used to confirm the origin of a honey (along with colour, taste, or smell) where no other suitable tests are available (Molan, 1998). Mānuka is an example where there are tests such as the MPI 5 Attributes that are specific to mānuka (Ministry for Primary Industries, 2018). On the other hand, thyme honey has no such chemical tests offered commercially, so when thyme honey is marketed overseas, its quality often is assessed by its distinctive smell and taste, and its pollen count.

How laboratories carry out a pollen count test

Pollen counting is made up of two main parts. In the first, the total number of pollen grains per 10 grams in the sample are estimated. In the other, the pollens are identified back to the plant that they came from, to give an estimated percentage of pollens from different sources.

Total pollen count

The honey sample is mixed well, and a sub-sample is taken and weighed. This sub-sample is dissolved, then washed several times before staining with a dye to make it easier to see and count the pollen grains under a microscope. Pollen grains in a known amount of the sample are then counted, and these results are used to estimate the total pollen concentration present per 10 grams of honey.

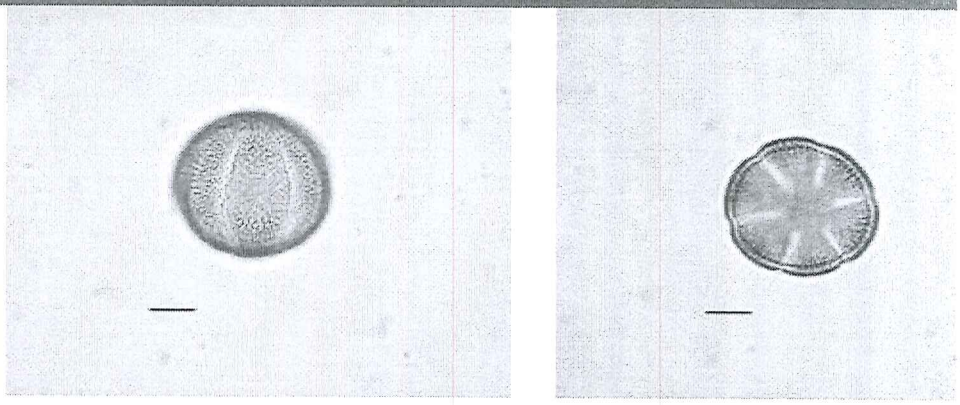

Figure 1. Acetolysed pollen grains of thyme (Thymus officinalis) with equatorial view on the left and polar view on the right. Scale bar = 10 microns. The detailed features are clear and distinct. Images: Xun Li, GNS Science.

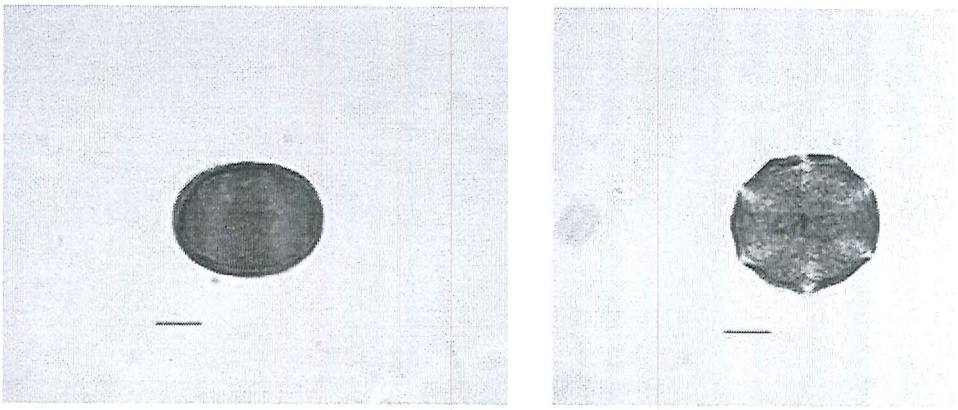

Figure 2. Non-acetolysed pollen grains of thyme (Thymus officinalis) with equatorial view on the left and polar view on the right. Scale bar = 10 microns. The detailed features are not very clear or distinct compared to the acetolysed pollen in Figure 1. Images: Xun Li, GNS Science.

Pollen identification

To identify specific pollen grains, a process known as acetolysis is normally used. Acetolysis removes debris from the sample by blasting the pollen grains with harsh chemicals. This also removes some material from the surface of the pollen grains themselves, making their skeletal features appear so they are easier to identify. After washing several times to remove any excess chemicals, the sample is stained and the pollen grains are identified by eye using a light microscope with high magnification (refer to Figures 1 and 2 above).

Different laboratories will identify different numbers of pollen grains depending on their own method requirements—ranging from less than 100 to more than 500. Because the identification step relies on a skilled person to identify each pollen by eye, the process takes longer if a larger total number of grains are identified. The results are reported as the

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percentage of the total pollens identified that come from different plant sources. The cost of a pollen count is often linked to the number of pollen grains that are identified in each sample.

Pollen count applications

Pollen counting can be valuable for floral types where no chemical-based tests are available for that floral type and where the representation of that pollen in honey is well understood (described further below). This applies to many New Zealand floral plant varieties as outlined by BPSC (2008), including clover, kāmahi and tawari.

From an authenticity point of view, presence of a certain pollen type can confirm regional origin; e.g., differentiating South Otago thyme honey from thyme honey that comes from Europe (Molan, 1998).

Of particular interest perhaps for hobbyist or new beekeepers is the use of pollen counting as an indicator of where your bees have been foraging. This information can be just as useful for more experienced beekeepers, not only to use as an indicator of foraging patterns to make sure bees are getting optimum nutrition from their environment, but also to target specific nectar sources in the foraging range of an apiary site (Newstrom-Lloyd, Raine, & Li, 2017, October).

Limitations of using pollen count to determine floral origin

Collection of pollen and nectar

It is important to remember that honey is made from nectar—not pollen. It is a common misconception that identifying the major pollen types in a honey is an absolute way of confirming what the main nectar source was to make a honey. Pollen and nectar make up different parts of a bee's diet, so bees will choose plants that provide them with the best nutrition (protein from pollen and carbohydrates from nectar), which often will not be provided by the same plant (Molan, 1998).

Over and under representation of pollen in honey

Interpreting the results of a pollen count is not simple, as some pollens can be over-represented or under-represented in honey (compared with the source of the nectar in the honey) depending on the characteristics of the particular flowers or plants involved.

One of the major reasons for this is the structure of the flowers that bees are visiting when foraging for nectar. Pollen may be collected at the same time as nectar when pollen grains fall or brush off into the nectaries of flowers. A foraging bee is more likely to brush pollen into the nectary of a plant that has its anthers (pollen producers) close to the nectary (such as white clover), than one that has its anthers far from, or below the nectary, such as is the case with rewarewa or tawari (Newstrom-Lloyd, Raine, & Li, 2017, November; Molan, 1998). For this reason, and using these same examples, clover pollen is considered to be 'normally represented' in honey, whereas rewarewa and tawari pollen are considered to be 'under represented' in honey (Newstrom-Lloyd, Raine, & Li, 2017, November; Moar, 1985).

Representation of pollen in honey	Floral type
Under-represented	Citrus, Pōhutukawa, Rewarewa, Tawari, Thyme
Normally-represented	Clover, Southern Rata, Vipers Bugloss
Over-represented	Kāmahi, Mānuka/Kānuka

Table 1: Outline of the representation of different pollen types in honey based on data from BPSC (2018) and Moar (1985).

For a detailed explanation about how to determine if pollen is over-represented, under-represented or has an average representation in nectar sources, see the article 'Pondering over and under representation of pollen in nectar' by Dr Linda Newstrom-Lloyd, Dr Ian Raine and Dr Xun Li (see reference at the end of the article).

Another cause for misleading pollen counts is plants that produce nectar but produce little to no pollen. As an example, despite its distinctive smell and taste, thyme honey often has a low total pollen count. The reason being that some thyme flowers produce nectar and pollen, and others produce nectar only. This means that there is often less thyme pollen in the honey compared to the amount of thyme nectar collected, so thyme is considered an under-represented pollen type (Molan, 1998).

Misleading sources of pollen

It is possible for pollen from non-nectar sources to end up in honey too. Honeydew is an example of a non-nectar food source that often contains windborne pollen from other plants. When bees feed on the honeydew, they carry these foreign pollens back to the hive where it makes its way into the honey and can be picked up in a pollen count (Moar, 1985; Molan, 1998).

Pollen counting and mānuka

Pollen counting is poorly suited to mānuka *(Leptospermum scoparium)*, as the pollen grains appear visually to be almost identical to kānuka *(Kunzea ericoides)* under a light microscope. Although it is possible to differentiate between mānuka and kānuka pollen, as demonstrated by work carried out by GNS Science (Li et al., 2016), it requires a very high level of expertise and can be labour intensive. For this reason, most laboratories will list a 'mānuka/kānuka type' pollen count where the pollen grains are indistinguishable.

For identification of mānuka, it is most reliable to use chemical-based tests such as the MPI

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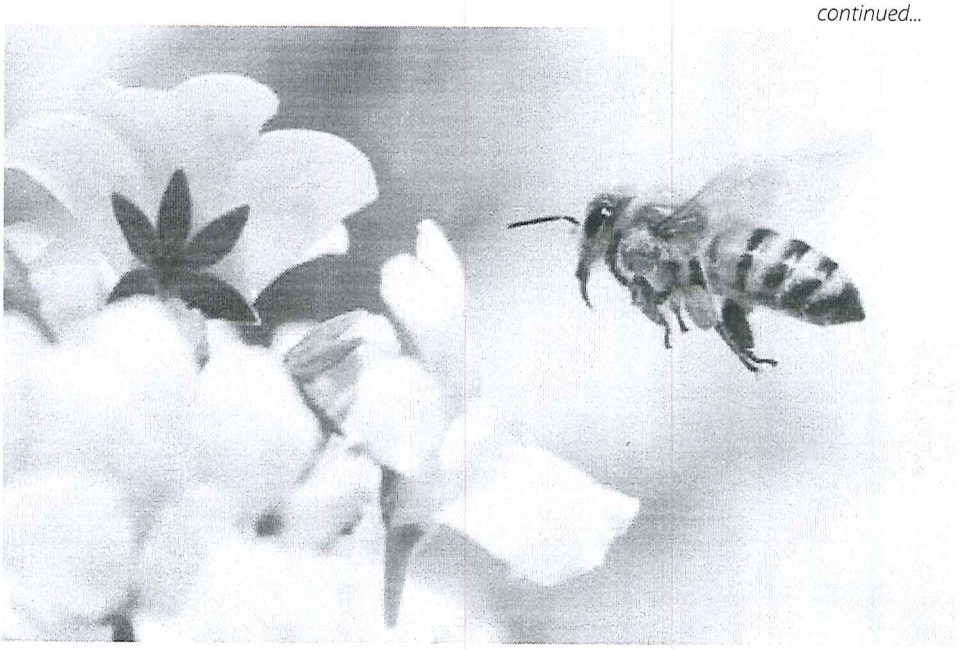

5 Attributes, which include unique chemical markers derived from mānuka nectar to help classify mānuka honey (Ministry for Primary Industries, 2018).

Conclusion

As long as limitations are factored into the interpretation of a pollen count, it can be a very valuable tool for honey classification. Applications of a pollen count include understanding bee foraging patterns, optimising honey production, and marketing unique floral types. Until more chemical marker tests are developed that are specific to nectar from other floral varieties, pollen counting is a useful tool to add value to your honey and beekeeping operation.

References

[BPSC] Bee Products Standards Council. (2008). NZ honey profiles and minimum criteria for monofloral 'varieties'. Accessed March 1, 2019 from https://apinz.org.nz/wp-content/uploads/2017/09/New-Zealand-Honey-characteristics-10June2008.pdf

Li, X., Raine, J. I., & de Lange, P. J. (2016). Differentiation of manuka and kanuka pollen in honey. Apiculture New Zealand National Conference, 19-21 June 2016, Rotorua. Available online at http://apicultureconference2016.co.nz/wp-content/uploads/2016/07/Poster-GNS-science-manuka_kanuka-poster-copy.pdf

Ministry for Primary Industries. (2018). Animal Products Notice: General Requirements for Bee Products. Accessed March 6, 2019 from https://www.mpi.govt.nz/growing-and-harvesting/honey-and-bees/manuka-honey/

Moar, N. T. (1985). Pollen analysis of New Zealand honey. *New Zealand Journal of Agricultural Research, 28,* 39–70.

Molan, P. (1998). The limitations of the methods of identifying the floral source of honeys. *Bee World Journal, 79* (2), 59–68.

Newstrom-Lloyd, L., Raine, I., & Li, X. (2017, October). How to decipher a pollen profile. *New Zealand Beekeeper, 26* (9), 19–21.

Newstrom-Lloyd, L., Raine, I., & Li, X. (2017, November). Pondering over and under representation in nectar. *New Zealand Beekeeper, 26* (10), 25–27.

Waters, R. (1915). Pollen grains as source-indicators of honey. *The Journal of Agriculture, 11,* 213–215.

EDUCATION

APINZ APPRENTICESHIP UPDATE

Stuart Fraser, Chair, ApiNZ Education and Skills Focus Group

The season is almost finished and our first group of participating apprentices and businesses are settling into the theory components of the Level 3 Certificate. Having worked through the practical components while the season has been progressing has meant almost all learning has been done 'on the job'.

Cambridge Bee Products (Prolife Foods) is our latest group to get under way in the ApiNZ Apprenticeship programme. Left to right: Joel Perry, Mackinnon Miller (Mac), Andrew George, Benjamin Johnstone (Ben), ApiNZ Education and Skills Focus Group Chair Stuart Fraser. Photo supplied by Stuart Fraser.

This is a major bonus for both business and apprentice alike, as it means the benefits of learning are practised immediately. It also helps that the mentor and assessor can work alongside the apprentice to support the learning while the practical application is taking place.

The numbers of participating businesses and apprentices in this first year are fantastic. With over 75 participants enrolled in online learning, the Focus Group team members are really pleased to be able to see the benefits of a National Standard for Learning and Achievement being taken up by a wide range of businesses. Both smaller and larger businesses are grabbing the opportunity to get engaged and put their teams through this training.

The recent announcement of a restructuring for learning institutions should lead to an even better opportunity for the apiculture industry.

It will be some time before the consultation with all parties is complete, but the timeline for change looks suited to how we might progress future learning achievement and recognition for higher levels.

Apprentices and businesses can rest assured there is no change to the current programme for achievement under the Level 3 and 4 Certificates or the Apprenticeship programme. Primary ITO will still be providing support throughout the course work and pastoral care where required.

And of course, if you have any questions about your learning pathway for the future, please call me on 021 868 343 anytime. I'm very happy to discuss with you.