**PhD working title:** Population genetics and ecology of the sugar beet leaf miners

**Funder:** BBSRC/BBRO (iCASE partner)

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**Project Summary:**

Sugar beet leaf miner are generally regarded as a periodic pest in the British sugar beet industry. In 2015-16 however, there were major outbreaks across British sugar beet with limited control options available. This led to the need for a deeper understanding of the leaf mining pest complex associated with British sugar beet. Our project aims to use both ecological and molecular tools to identify how many different sugar beet leaf miner species exist, where they sit within the wider group of related species, whether they show particular host plant preferences and what parasitoids are associated with them. This will be the starting point in understanding this pest species complex and will lay a foundation for the future sustainable management of outbreaks.

**Key Objectives:**

1. How many species of sugar beet leaf miner are found in the UK?
2. What are the taxonomic features that distinguish the species from one another?
3. What are the relationships between the sugar beet leaf miners and other related species within the same genus?
4. What parasitoid species are associated with the sugar beet leaf miner complex?

**Current Outcomes:**

One of our main objectives within the parameters of this project was to identify the number of species within the *Pegomya* leaf mining complex which is associated with sugar beet. To do this we implemented the use of molecular tools, specifically a comparison of COI mitochondrial gene sequences, on samples primarily found across the UK, as well as a number of samples from Germany and the Netherlands. In addition to surveying leaf miner on sugar beet, we undertook to survey species of the sugar beet leaf miner on related host plants. This focused on sea beet, other cultivars within *Beta vulgaris*, spinach (*Spinacea oleracea*) and some samples from *Chenopodium* hosts within the UK.

We identified two key groups from the samples we collected during the course of this project. These groups appear to be defined based on their host plant associations. Group A was primarily found on sugar beet and sea beet, while group B was more widely spread across a range of different hosts, and exclusively on Swiss chard and *Chenopodium* sp. Leaf miner collected from beetroot were equally clustered between the two groups.



Relationships between *Pegomya* COI sequences depicting 2 distinct groups.

The figure above shows a haplotype network of *Pegomya* field specimens, indicating the relationships between 162 Cytochrome C Oxidase Subunit I (COI) sequences. The node size represents the number of sequences that are identical to one another, therefore clustering them within a single haplotype. The train tracks on the lines joining the nodes indicate the number of base pair differences between sequences.

We found that there are more tracks seen between the clustering of sequences within Group A and Group B, demonstrating enough genetic distance between the two groups to label these as potential species. Group A likely corresponds to *P.betae* and Group B to *P.hyoscyami* based on high percentage matches between our own sequences and those from the GenBank database. Further investigations into these species groups are required however before confirming species names in full.

**Main outcome:** Our findings suggest that there are two distinct ‘species’ groups found within the UK, each with different host plant associations that distinguish them. Group A was predominately found on sugar beet, suggesting a close relationship with this host, whereas Group B was found on a range of host plants. This shows that there is potential for dual species infestations of sugar beet within the UK which should be investigated further in regards to past and future leaf miner outbreaks.

**Wider importance:** Our research shows the value of using molecular tools combined with the knowledge of pest life history in understanding pest outbreaks and the importance of molecular tools for the future application of rapid species identification of pests in the field.