**Quick update on what I have been doing**

I finished the lab work Yannick asked me to do and informed him I'm no longer available for any more tasks. Since Monday I have been collecting national level regulatory/product label info about the usage of flupyradifurone, sulfoxaflor and cyantraniliprole formulations. I’ve done that for all EU nations, UK, NZ, AU, Canada, US, Brazil and China. I've attached the spreadsheet. As you can see for the countries I surveyed Sivanto Prime (flupyradifurone) stands out in terms of usage, especially once use restrictions are accounted for. Many EU countries allow its application during flowering as long as it isn't coapplied with sterol inhibitor fungicides. I have attached the spreadsheet I’ve compiled. Even in the unlikely situation I am not allowed to switch supervisors I imagine this will be useful to you.

I searched web of science for:

((flupyradifurone OR butenolide\*) AND (bees OR pollinator\* OR bee OR bumble OR honey OR solitary OR honeybee OR bumblebee))

35 papers exist, 18 of which are relevant. All of them are on honeybees bar one that looked at LD50s (Bass’s Group at Exeter). To date, nothing exists for bumblebees and flupyradifurone, which is very surprising considering its usage.

The big question is available residue studies. These studies have been performed for pollen and nectar foraged by honey bees. They are referenced in regulatory documents and the EPA Environmental and Ecological Risk Assessment provides maximum residue values, “generally represented by the highest daily average residues during study”. I have attached this document. Table 28 (Page 58) contains an overview of the residue studies with the maximum residue values. Figure 6 (Page 104) even plots some of this data on a line graph, with foraged nectar values included. Unfortunately they don’t do this for foraged pollen.

Table 37 (Page 82) has an overview of regulatory semi field and field studies, some of which took residue measurements. Two of these studies quote ranges of residue measurements in foraged pollen and nectar. One has pollen residues at 1.1.-6.2ppm collected 7 days after 2nd foliar spray application. The other has 3.0-8.1ppm collected 7 days after 3rd application (one directly to soil on day of sowing, two to foliage). As you’ll see if you look at Table 37 many other values and ranges are quoted but there is either no specific time after application stated or the time between application and sampling is uninformative for our purposes. For the existing regulatory semi-field and field studies all were performed on honey bees and they all have issues (low sample size, treatment regime wasn’t according to label recommendations, etc). It would be great to gain access to these studies. I’m going to ask Alberto if this is possibly/likely. I know that the test data decisions are based on can be requested in Canada. Hopefully the EU has something similar.

There is one published paper performed on flupyradifurone and crop usage in the field ([link](https://academic.oup.com/jee/article/109/5/1967/2201782)). Here is an overview of their sampling strategy with the important residue values:

Composite samples of pollen (bee bread) and nectar (unprocessed) from colony stores (i.e. from the wax comb) were collected during peak bloom (i.e. **about 5 d after the second application with flupyradifurone**) to characterize in-hive residue levels of flupyradifurone. To gather composite samples, all three colonies per study field were opened and approximately five cells of unprocessed nectar or bee bread (minimum of 3 g) were taken from each of the colonies and placed into a single collecting container. Four composite samples of unprocessed nectar and bee bread were taken per study field (64 samples overall). **Flup Nectar Median = 201.5ppb (n=16), Flup Pollen Median = 512.5ppb (n=16).** Treatment Regime - The four buckwheat treatment fields were treated twice with flupyradifurone via foliar spray at the highest single application rate for buckwheat, which corresponds to 205 g ai/ha per individual foliar application. As two sequential applications were made, the buckwheat crop also received the maximum cumulative seasonal application rate allowed by the label, which corresponds to 410 g ai/ha. The application volume was ∼94 L/ha, as recommended in the Sivanto label for foliar ground application of cereal grain crops, including buckwheat. This cumulative application rate of flupyradifurone is also the maximum allowed for all other crops, including citrus and other bee attractive crops.

Unfortunately samples were only collected at one timepoint.

Finally, there are only ld50 values available for Sivanto Prime vs A.I. These are:

Sivanto (SL)200

For Honeybee LD50 (µg/bee)

* Acute Oral
  + a.s = 1.2
  + Sivanto SL200 = 3.2 (a.s)
* Acute Contact
  + a.s = 122.8
  + Sivanto SL200 = 15.7 (a.s)

For Bumblebee

* Acute Contact
  + Sivanto >100 (a.s)
* Acute Oral
  + a.s. >8.52 μg a.i./bee
  + 48h.

I know these aren’t the most informative but there is some difference between Sivanto and the pure active ingredient.

So in summary, I think flupyradifurone vs Sivanto Prime is the most impactful comparison. Even if there is no difference between the formulation and ai a properly designed study for wild bees on the fitness effects of flupyradifurone would be valuable. Of course, this relies on getting access to reliable residue data for foraged pollen and nectar.