3/13/2020

Pollen Analyses (pilot trial)

This work was funded by:
THE JAMES M. COX FOUNDATION
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In the summer of 2019, BIP conducted a pilot study to apprise the potential value of new diagnostic tools assessing pollen quality. In addition to testing the collaboration with a partner lab, it offered us the opportunity to judge the practical usefulness of the results provided to the beekeeper.

Study Design

18 samples collected during 3 sampling events in 3 yards of 2 beekeeping operations (MD and GA). The corbicular pollen collected by 4 colonies over 12-24h was pooled for analyses.

x 3 (yards) x 2 (states)

x 3 sampling periods:

12-24h **Pre-bloom** **Peak bloom** **Post-bloom**
(of "target" crop: cotton (GA) or soybeans (MD))

Protein content
Amino acids composition
Plant type composition (500 pellets)
Heavy metals contaminants

Collection dates
GA: 6/19/2019; 7/24/2019; 9/1/2019 **MD**: 6/26/2019; 7/27/2019; 8/19/2019

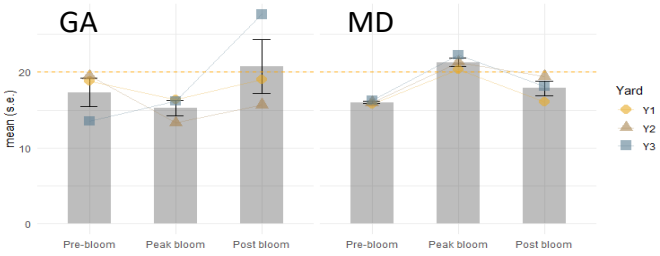
Heavy metals

As bees forage in their environment, they can pick up pollutants from various sources and bring them back to the colony. Monitoring at the landscape level can inform us about potential contaminants making their way into the colony, in bee products, as well as provide a picture of the contamination present in the surrounding environment (Aldgini et al., 2019).

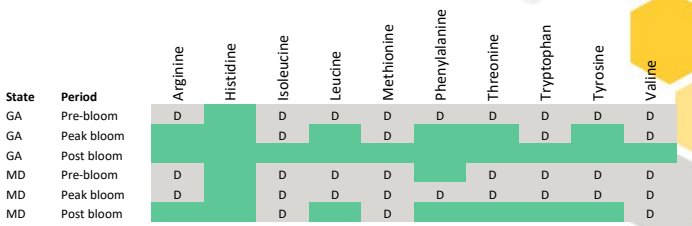
In GA, Chromium was found elevated during the first sampling event; Arsenic was also found in elevated levels compared to expected background levels of Arsenic in the environment. No heavy metal was found above acceptable levels in samples collected during this study. (see figure on second page)

Protein content

The crude protein concentration of pollen (%) is an indication of the quantity of protein available to the honey bees. Those levels vary depending on floral source, usually ranging from 7 to 40% (Somerville & Nicol, 2006). Most samples showed insufficient crude protein content to meet a colony's optimal brood rearing requirements (20%) (Kleinschmidt & Kondos, 1976).



Essential Amino acids (Aa)

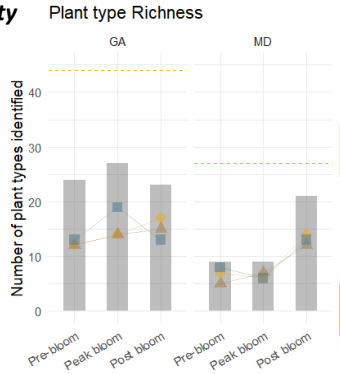


(see values on page 2)

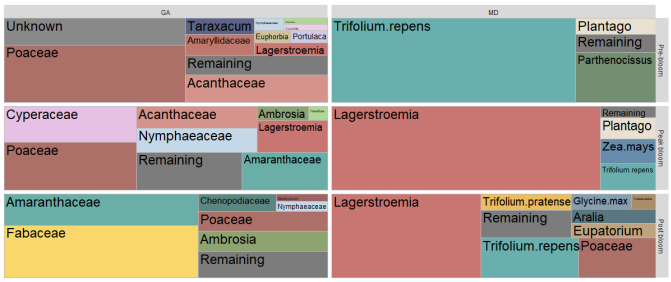
Of the 10 pollen Aa essential for honey bee nutritional needs (de Groot, 1953), the pollen collected during this study showed deficiencies (marked "D") in all but one (histidine). Most deficient were isoleucine, methionine and valine. If the second sampling in MD had enough crude protein content (quantity), it was of poor quality, with deficiencies in 9 out of 10 essential Aa.

Plant type richness and diversity

44 plant types (from 29 families) were identified in GA samples compared to only 27 in MD (from 17 families). Although the plants present during each sampling event changed, floral richness remained fairly consistent across all three sampling events in GA (24, 27, 23). In MD, richness peaked in the 3rd sampling event (9, 9, 21). The dominant plant types for each sampling round



Average pellets counts of dominant plant types



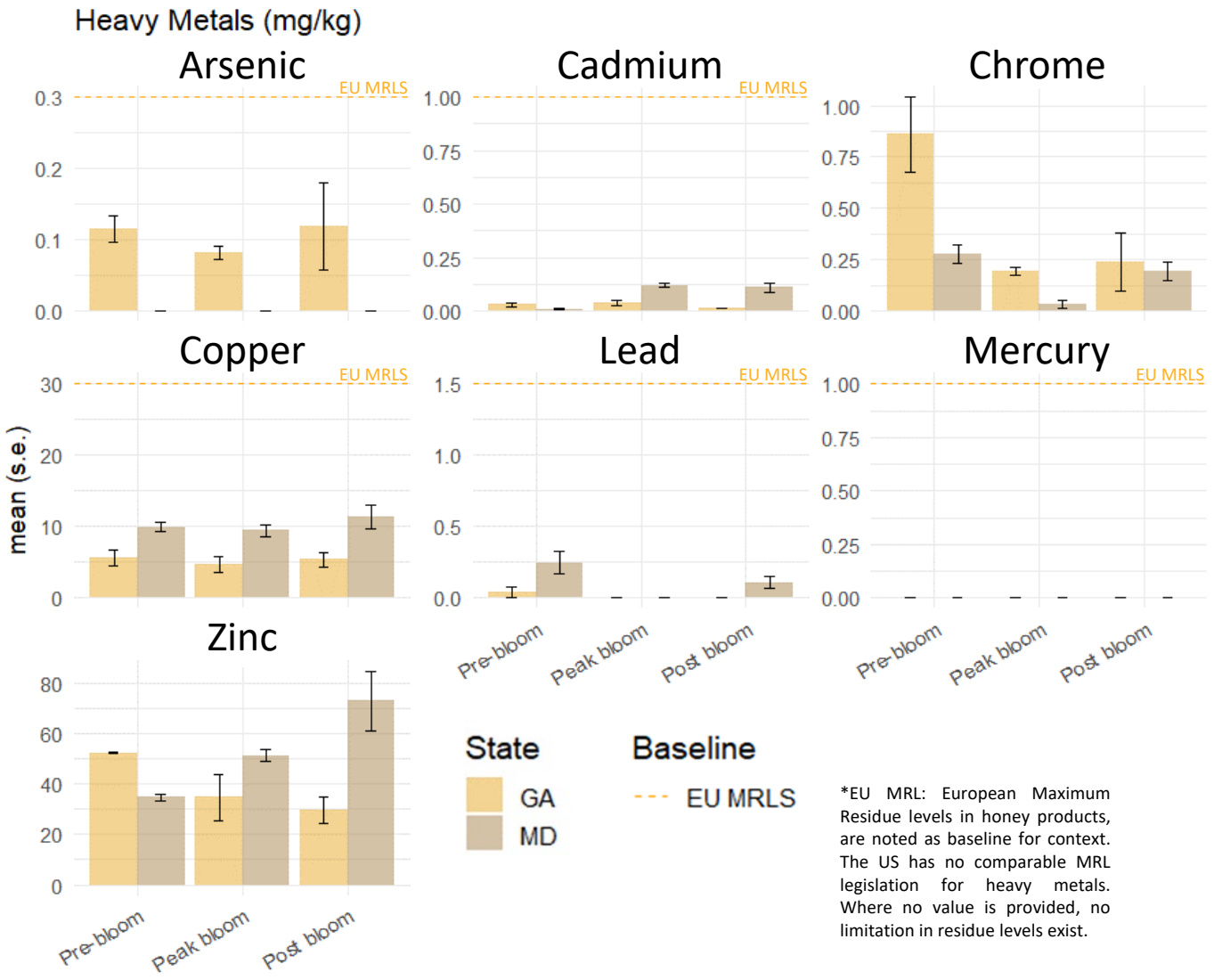
In GA, the rise in Aa quality seem most likely associated with the appearance of *Fabaceae* in the 3rd sampling event (Yard 3). In MD, the near absolute dominance of *Lagerstroemia* (crape myrtle) in the second sampling round seem to have provided ample quantity of pollen to the bees, but of low quality.

The "target" cultivated crops, next to which the colonies were located, cotton (*Gossypium*) in GA and soybeans (*Glycine max*) in MD, were both only found in one of the 9 sample and in low quantity (4% of the grains counted in GA, 10% in MD), confirming their reputation to be a crop of little value to honey bees as a pollen source.

In summary, no heavy metal was found above acceptable levels in the samples collected. Overall, the samples were deficient in both crude protein content and in several essential amino acids to support optimal brood rearing in honey bee colonies, particularly in the first two sampling rounds. Assuming those conditions are representative of typical conditions in that place and time of year, supplemental protein feeding could prove beneficial next year.

Citations: Aldgini, et al. (2019) Determination of metals as bio indicators in some selected bee pollen samples from Jordan. *Saudi Journal of Biological Sciences*. 26 (7), 1418–1422 ; **de Groot (1953)** *Protein and amino acid requirements of the honeybee (Apis mellifica L.)* ; **Kleinschmidt & Kondos (1976)** Influence of crude protein levels on colony production. *Australasian beekeeper* ; **Somerville & Nicol (2006)** Crude protein and amino acid composition of honey bee-collected pollen pellets from south-east Australia and a note on laboratory disparity. *Australian Journal of Experimental Agriculture*. 46 (1), 141–149.

Additional Figures



*EU MRL: European Maximum Residue levels in honey products, are noted as baseline for context. The US has no comparable MRL legislation for heavy metals. Where no value is provided, no limitation in residue levels exist.

Essential Amino acids (Aa)

Mean g Aa/16 g of N (standard error)		Arginine	Histidine	Isoleucine	Leucine	Methionine	Phenylalanine	Threonine	Tryptophan	Tyrosine	Valine
State	**Period**										
GA	Pre-bloom	1.8 (0.22)	1.9 (0.34)	1 (0.18)	2.1 (0.38)	0.6 (0.02)	1.7 (0.18)	1.4 (0.23)	0.4 (0.02)	1.3 (0.13)	1.2 (0.24)
GA	Peak bloom	4.5 (0.4)	3.5 (0.16)	3.1 (0.14)	5.8 (0.47)	1 (0.19)	4.2 (0.2)	3.6 (0.25)	0.9 (0.05)	3.2 (0.19)	3.5 (0.17)
GA	Post bloom	5.8 (0.85)	4.5 (0.54)	4.2 (0.67)	8.2 (1.48)	1.6 (0.58)	6.1 (0.75)	5.2 (0.73)	1.2 (0.09)	4.6 (0.56)	4.8 (0.83)
MD	Pre-bloom	2.7 (1.02)	2.3 (0.7)	1.7 (0.84)	3.4 (1.56)	0.8 (0.17)	2.7 (0.97)	2.2 (0.93)	0.6 (0.19)	2.1 (0.72)	2 (0.98)
MD	Peak bloom	2.5 (0.05)	1.8 (0.01)	1.4 (0.04)	2.9 (0.09)	0.6 (0.01)	2.1 (0.03)	1.9 (0.04)	0.5 (0.01)	1.6 (0.06)	1.7 (0.05)
MD	Post bloom	5.8 (0.83)	3.9 (0.12)	2.9 (0.22)	6.4 (0.65)	0.9 (0.04)	5.1 (0.63)	4.1 (0.19)	1 (0.07)	3.8 (0.51)	3.4 (0.33)
de Groot *		3	1.5	4	4.5	1.5	2.5	3	1	3	4

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