

Subsurface Pest, Soil and Microbiome Detection

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Assumptions/Questions

- ▶ Pesticide Program Dialogue Committee – Emerging Technologies Workgroup “Charge Questions” require knowledge of diverse application technologies.
- ▶ Does the current “Emerging Technology List” consider soil sensing and resulting consequences?
- ▶ Below surface, non-destructive pest and microbiome detection presents unique challenges.
- ▶ Soil, root health and microbiome interactions have moved to the forefront cropping efficiency.

Emerging Technologies - Examples

- ▶ Biome Makers – “...measure the biological quality of the soil and deliver agronomic insights to optimize farm operations”
 - ▶ Microbial (pest) populations, interactions between microbial species, hormone production, stress adaptation, macro and micro element status, and solutions.
- ▶ Pattern Ag – “We can display microbial insights at a sub-field, field, and operation level, while providing relevant benchmarks to help you interpret and act on the results.”
 - ▶ Based on DNA patterns in soil suggesting pest species.
 - ▶ Predict where target pests are likely to be present at economically viable levels to warrant treatment
- ▶ Geegah, Inc. – seeking to deploy inexpensive, ultrasonic soil imagers with resolutions <math>< 1\mu\text{m}</math> resolution for near-instant identification of:
 - ▶ Nematodes (100-2500 μm)
 - ▶ Fungi (10-1000 μm)
 - ▶ Bacteria (2-3 μm)
 - ▶ Soil organic matter (OM) layers (0.1-100 μm) and more

Examples

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BIOME MAKERS

Quantification based on number of cells per gram of soil amendment and grouped by abundance

451 *Oscillospira* sp. 4.27e+5

452 *Paracoccus carotinifaciens* 4.27e+5

453 *Pseudomonas azotoformans* 4.27e+5

454 *Pseudonocardia halophobica* 4.27e+5

455 *Tepidamorphus gemmatus* 4.27e+5

456 *Bacillus firmus* 3.97e+5

457 *Bacillus aeris* 3.84e+5

458 *Actinomadura vinacea* 3.35e+5

472 *Segetibacter* sp. 2.68e+5

473 *Acinetobacter venetianus* 2.56e+5

474 *Arthrobacter* sp. 2.56e+5

475 *Bacillus coagulans* 2.56e+5

476 *Flavobacterium caeni* 2.56e+5

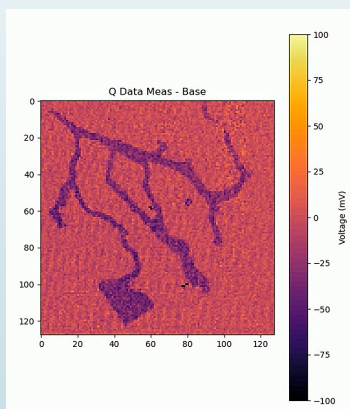
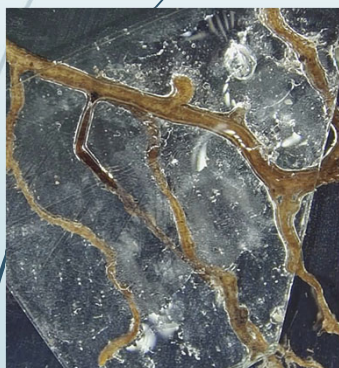
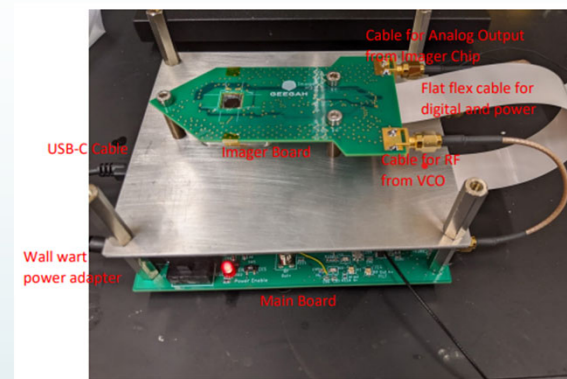
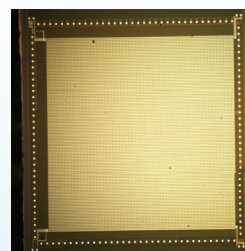
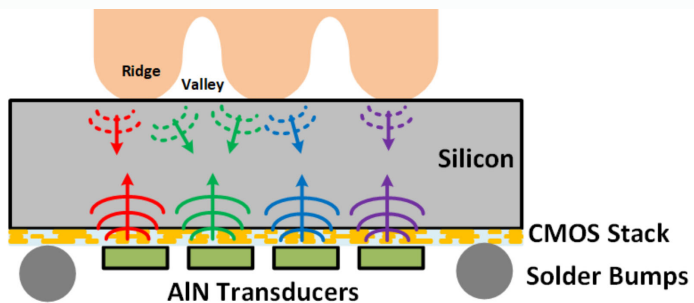
477 *Alicyclobacillus herbarius* 2.24e+5

478 *Desulfotibacter* sp. 2.24e+5

479 *Desulfurispora* sp. 2.14e+5

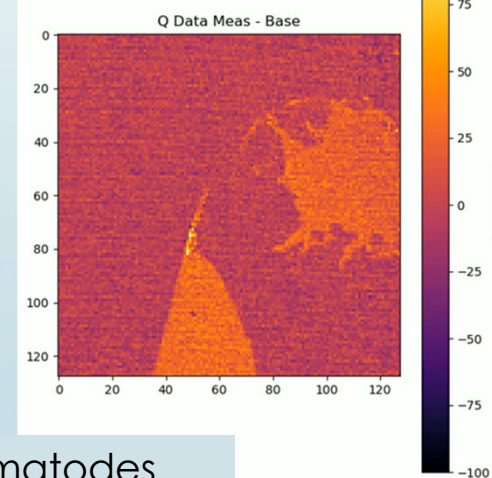
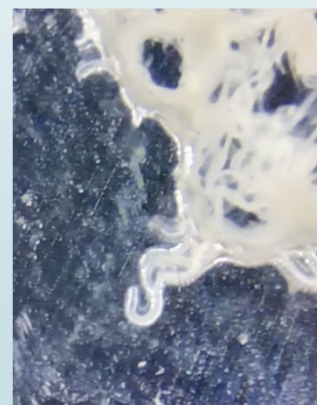
Examples

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Roots/Water/Salinity/Temperature

CMOS Integrated GHz UltraSound Chips for Imaging, Sensing, and Timing = Soil TriCorder. True Single Chip IoT Solution for Precision Agriculture



Nematodes

Conclusions

- Recognition of below ground targets will provide new opportunities to address deficiencies, pests and 'soil health' in detail not possible today.
- Soil sensing will lead to real-time targeted applications with potentially more preplant as well as more at-plant treatment.
- Barriers to sampling soils (such as cost and time) are being addressed. Moving from "acres per sample to samples per acre" will greatly facilitate precision agriculture.
- Precision agriculture will become more precise, with improved below ground target definition.
- Soils, microbiomes and root health measurements will provide a wealth of opportunities to address via agronomic practices, as well as applications of microbials, chemicals, and nutrients.

Thank You

The preceding opinions are not necessarily the position of AMVAC Chemical Corporation.

Agenda

6/2 Update: Adding RPAAS Workshop as an agenda item and adding draft agenda.

Hello group, Here is the agenda for Thursday afternoon:

Approve notes from April 8th and May 6th meetings

Discuss PPDC and feedback received

2021 RPAAS Workshop

Peter Porpiglia will talk to the group about subsurface sensing of pests not visible for prescriptive application

Consider deliverable two from the ETWG for the Fall PPDC meeting

- "Deep dive on Autonomous Application Platforms operated remotely and/or manually" document
 - Input from the group on what it should look like/how to structure it
 - How can the group divide and conquer the different sections of the document?

Please reach out to Shannon Jewell (jewell.shannon@epa.gov) with questions or concerns.