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Metabolomics-Driven Pest and Disease Management in Horticulture

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Background

Pests and pathogens cause major losses in Canadian horticulture as the number of registered control products shrink and cases of pesticide resistance grow.

Metabolomics can profile the chemical signatures plants produce and provide insights into the plant–pest–microbe interactions behind them.

Using this process, we can:

- **Identify** signatures of pest and disease resistance
- **Link** chemistry to cultivar, crop inputs and the phytobiome
- **Translate** markers into tools for breeders and growers

Our approach

1 Sample
Leaf, root or pest tissue from contrasting cultivars, treatments or populations

2 Profile
Untargeted UPLC-QTOF-MS (ESI+/−) metabolite profiling

3 Analyze
PCA and multivariate statistics to find features linked to the phenotype

4 Validate
Confirm structures and retest markers in bioassays

5 Deploy
Screening assays, breeding targets and IPM guidance

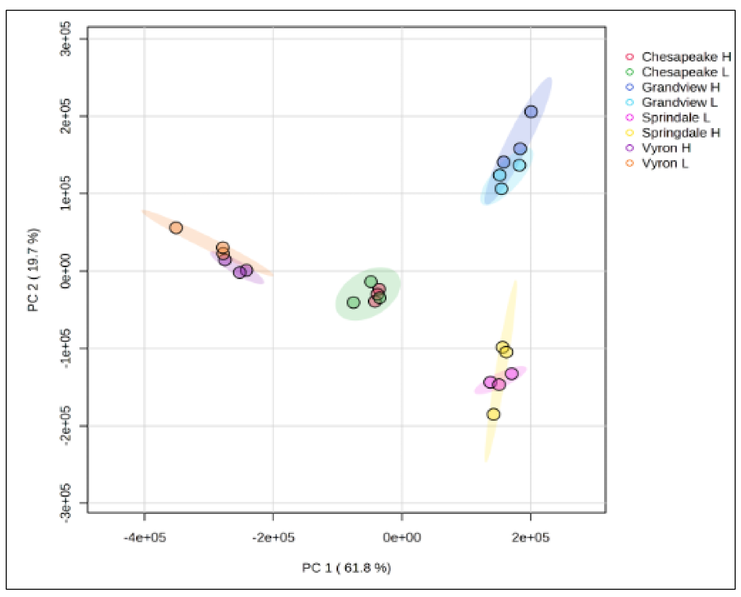
Metabolomics research in progress at Vineland

Mandevilla: cultivar chemistry databank for *Thrips parvispinus* resistance
Pepper: assessing aphid resistance to pesticides
Strawberry: screening for fungal disease resistance

Have a similar challenge? Let's talk.

Case study: thrips resistance in chrysanthemum, 2021-2023

- **Crops:** chrysanthemums, gerbera
- **Targets:** western flower thrips
- **Design:** resistant vs. susceptible cultivars; fertilizer and biostimulant treatments
- **Bioassays:** thrips oviposition, whole-plant counts
- **Analysis:** PCA, OPLS-DA, multivariate statistics (R, Python), mass spectral analysis (Progenesis QI)



Each cultivar has a distinct leaf chemistry
Principal Component Analysis (PCA) scores plot considering 3,850 mass features from four pot-mum cultivars at high (H) and low (L) fertilizer, Jan 2023 variety trial (n = 3). Vyron, the most thrips-susceptible cultivar, sits apart from Springdale, the least susceptible cultivar.

Metabolites of interest

Metabolite class	Role in plant defence
Flavonoid glycosides	Profiles linked to thrips resistance in mums
Hydroxycinnamic acids	Antifeedant; e.g., chlorogenic acid vs. thrips
Jasmonates and salicylic acid	Defence signalling against insects and pathogens
Terpenoids and volatiles	Repel pests; attract natural enemies
Detoxification metabolites	Signatures of insecticide resistance in pests

Leiss et al. 2009, Plant Physiol 150:1567; Tsao et al. 2003, J Nat Prod 66:1229; Tsao et al. 2005, J Chem Ecol 31:103

Key findings

10 candidate markers of thrips resistance or susceptibility in mums

20 candidate markers in gerbera, a related Asteraceae crop

1 flavonoid glycoside linked to thrips susceptibility in both crops

Applications

- **Cultivar screening:** rank cultivars for resistance to pests and diseases
- **Breeding:** deploy markers for faster selection resistant cultivars
- **Crop inputs:** see how fertilizer inputs and biostimulants shift plant defences
- **Monitoring:** early detection of pests and diseases

Conclusions and next steps

- Metabolomics turns plant chemistry into actionable pest and disease signatures, proven for thrips in chrysanthemums
- **Next:** validate markers across cultivars and crops
- **Next:** screen cultivars and chemistry databanks for breeders and data-driven cultivar selection

Scan to learn more and connect with our experts.

Let's collaborate
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