Influence of prophylactic insecticide use on decomposer communities in maize and soybean fields

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Prophylactic insecticides use is exceedingly common in corn and soy production.

- May Improve Yield
- Can Reduce Labor Input
- Insurance

Secondary Pest Outbreaks
Insecticide Resistance
Harm to people/wildlife
Disrupt Ecosystem Functioning

https://upload.wikimedia.org/wikipedia/commons/f/fc/Bt-toxin-crystals.jpg

Douglas & Tooker 2015
Decomposer communities perform ecological functions critical to agriculture

High exposure to soil applied insecticides

Objectives

Investigate if prophylactic insecticide use affects arthropod decomposers.

Expectations

Reduction in activities and densities

Investigate if this affects decomposition rate.

Reduced decomposition rate
Field experiment in maize and soy

- Untreated
- Pyrethroid
- Seed Coating
Methods: Pitfall sampling and litterbags
Macroinverts: Pyrethroid increased millipede activity-density

Mixed Model: millipedes = treat x field
- treat: $P = 0.0004$
- treat*field: $P = 0.0018$
- n=233
Mesofauna: Pyrethroid decreased mite density

Negative Binomial Mixed Model: mites = treat x date

- **treat**: $P = 0.026$
- **date**: $P < 0.0001$
- no interaction

$n=72$
Mesofauna: Seed treatment decreased collembola density

Poisson Mixed Model: collembola = treat x date
- treat: $P < 0.0001$
- date: $P < 0.0001$
- treat*date: $P < 0.001$

n=72
Seed treatments can increase decomposition

Repeated Measures Model: %remaining = treat x meshsize x date

- treat: $P < 0.079$
- meshsize: $P = 0.0006$
- date: $P < 0.0001$

- treat*date: $P = 0.028$
- meshsize*date: $P < 0.0001$

n=140
No yield advantage to using these insecticides

2016/2017 Soy Yield

- Control
- Pyrethroid
- Seed

2016
- Treatment
- \( P = 0.76 \) (n = 18)

2017
- Treatment
- \( P = 0.58 \) (n = 12)

2016 Corn Yield

- Control
- Pyrethroid
- Seed

\( P = 0.091 \) (n = 12)

PA state average
Conclusions / Next Steps

Does prophylactic insecticide use affect arthropod decomposers?

Possible Mechanisms

Yes

Direct toxicity - **Toxicity Assays**
Predator influence - **Predation Assays**

Does this affects decomposition rate?

Possibly

2 more batches of litterbags to analyze
Nutrient Dynamics – **litter & soil analysis**
Thank You! - Questions?
2nd Year of 3 year Experiment

- **Pitfalls**
- Litterbags 1
- Litterbags 2
- Litterbags 3

Timeline:
- **2017**: J, JL, A, S, O, N
Mesofauna sampling method
Mesofauna Population Dynamics

Poisson Mixed Model: collembola = treat*date
- treat: p < 0.0001
date: p < 0.0001
itreat*date: p < 0.001
n=72; soy plot only

Negative Binomial Mixed Model: mites = treat*date
- treat: p=0.0264
date: p < 0.0001
no significant interaction
n=72; soy plot only
Macrofauna exclusion decrease decomposition rate

Repeated Measures Model: %remaining = treat*meshsize*degreedays
- treat: p < 0.0790
- meshsize: p = 0.0006
- degreedays: p < 0.0001
- treat*degreedays: p = 0.0281
- meshsize*degreedays: p < 0.0001
n = 140; soy 2016 plot only

Coarse Mesh
Fine Mesh
Agronomic significance: No effect of pesticide treatments on yield

2016 Corn Yield

Tukey groupings with $\alpha=0.10$

treatment: $p=0.0911$

$n=12$
Objectives

Investigate if prophylactic pesticide use affects arthropod decomposers

Investigate if this affects decomposition rate.

Additional factors

Crop type
Role of macroinvertebrate
Crop residue age/seasonality