Post Harvest Management of Fruit Wastes to Manage Spotted-Wing Drosophila

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1

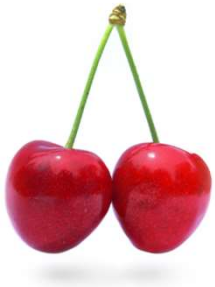
OUTLINE

1. *D. suzukii* as a post-harvest pest
2. Solarization, Crushing and Burial of fruit wastes
3. Composting of fruit wastes
4. Why/How does composting work?
5. Farm scale evaluation of waste tart cherry management

2

SUCEPTIBLE FRUIT

berries



cherries

rotting fruit

! How to dispose of fruit wastes?

(Asplen et al. 2015, Bal et al. 2017)

3

(Roberts et al. 2008, Shalini and Gupta 2010, Maiti et al. 2018)

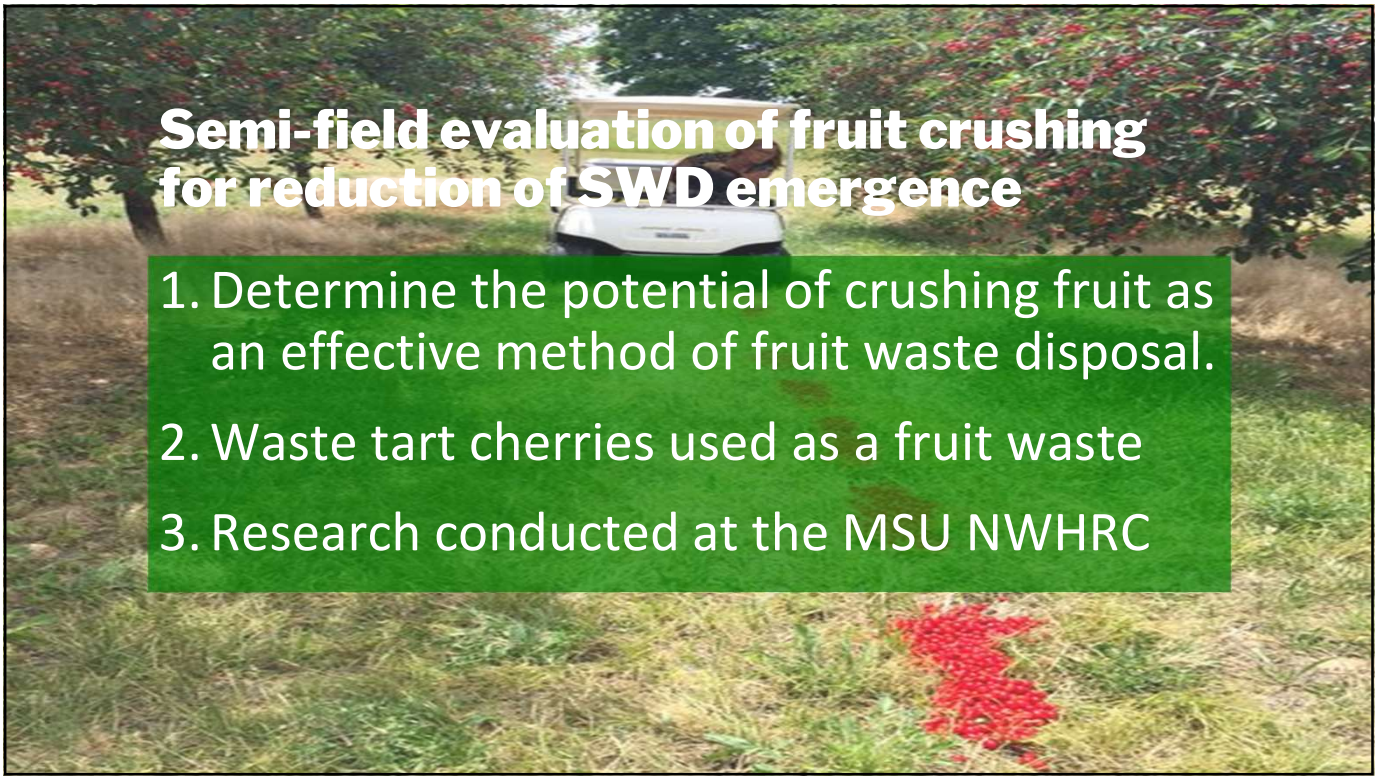
4

CURRENT OPTIONS

- Solarizing infested raspberries for 32 hours in plastic bags can reduce larval survival by 99%
- This practice is difficult to translate to non-berry crops and is impractical for the large quantities of fruit wastes typical of post sorting or processing operations
- What are alternative options?

(Haye et al. 2016, Leach et al. 2017)

5



Semi-field evaluation of fruit crushing for reduction of SWD emergence

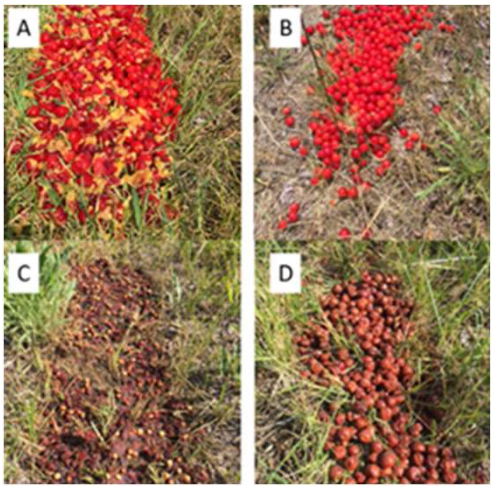
1. Determine the potential of crushing fruit as an effective method of fruit waste disposal.
2. Waste tart cherries used as a fruit waste
3. Research conducted at the MSU NWHRC

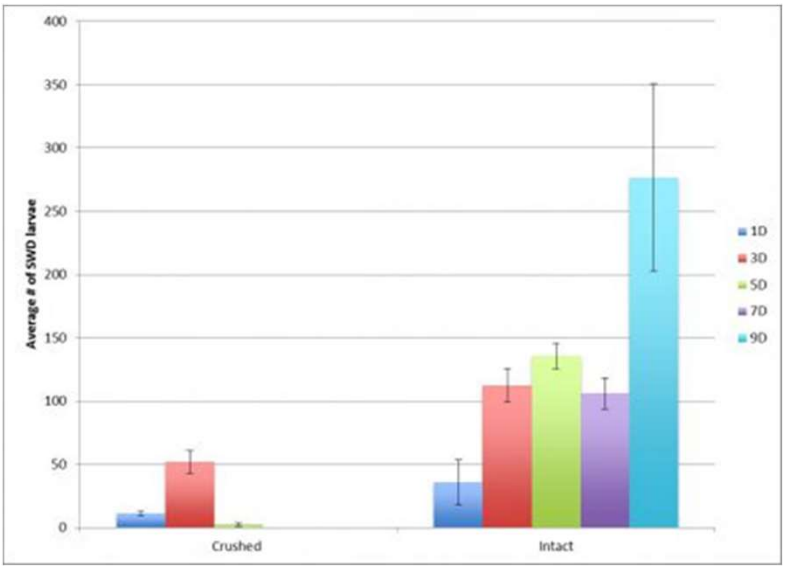
6

Tart cherries crushed with golf cart and evaluated in lab over time

7

Mean SWD emerged from crushed and uncrushed waste tart cherries over a 9-day period.





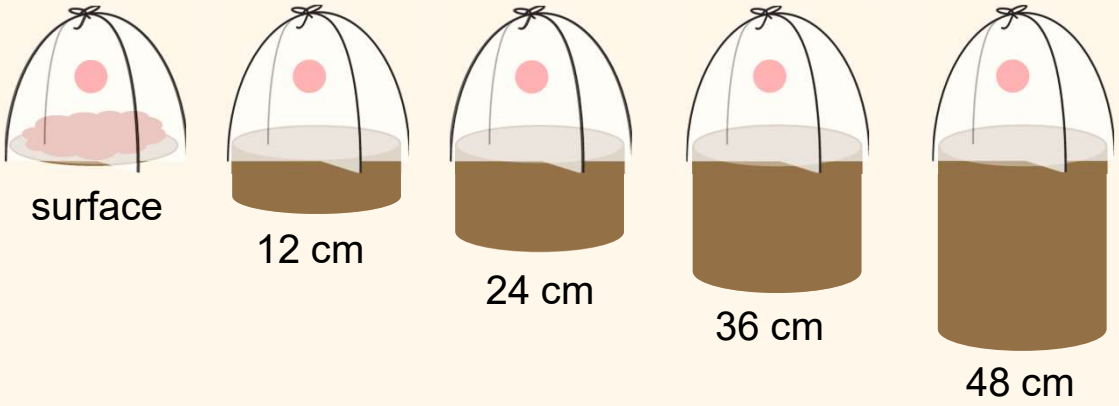
8

Semi-field evaluation of burial for reduction of SWD emergence

1. Determine the potential of burying SWD infested fruit as an effective method of fruit waste disposal.
2. Organic apple pomace (cider pressings) used as a fruit waste
3. Research conducted at the MSU campus

9

METHODS

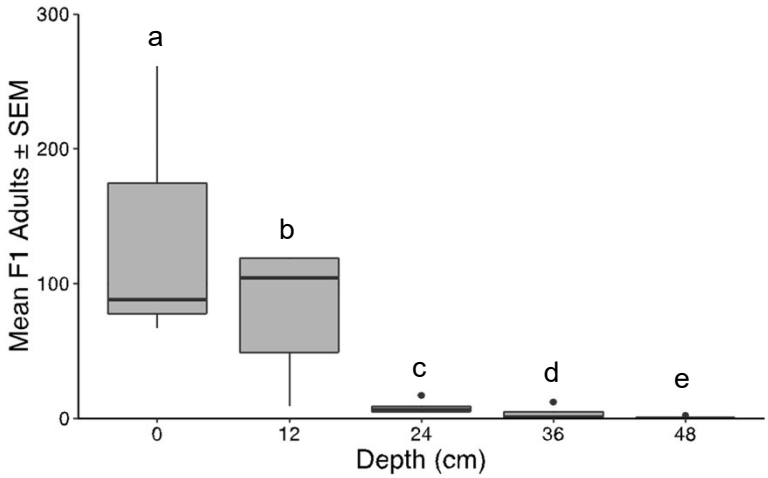


(Hooper and Grieshop 2019)

10

RESULTS

- Exponential decrease in emergence as burial depth decreased
- 48 cm achieved a 99% reduction
- 24 cm achieved a 97% reduction



$F_{4, 20} = 21.58$, $p = < 0.001$, $\alpha = 0.05$

glm(emergence ~ depth, family= Poisson) in R 3.4.0.

(Hooper and Grieshop 2019)

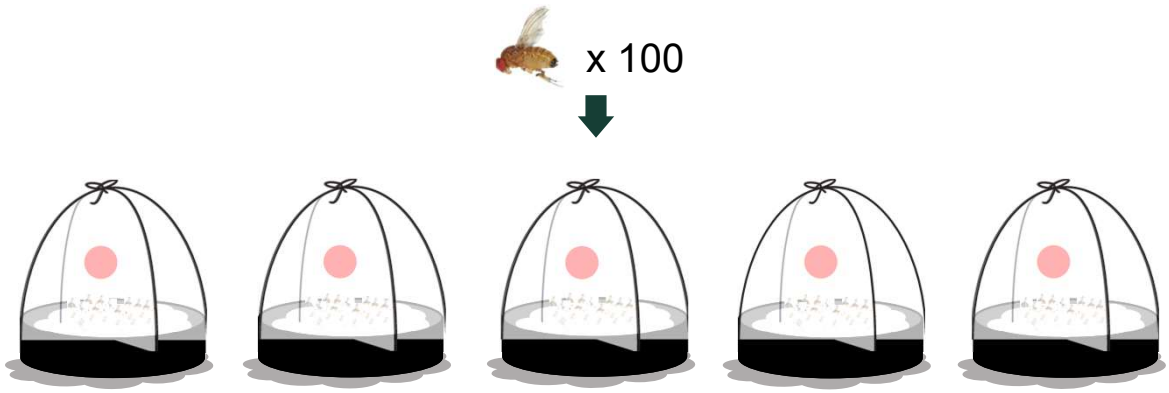
11

Semi-field evaluation of composting for reduction of SWD emergence

1. Determine the potential of composting SWD susceptible fruit as an effective method of fruit waste disposal.
2. Organic apple pomace (cider pressings) used as a fruit waste
3. Organic chicken manure used as additional feedstock

12

METHODS



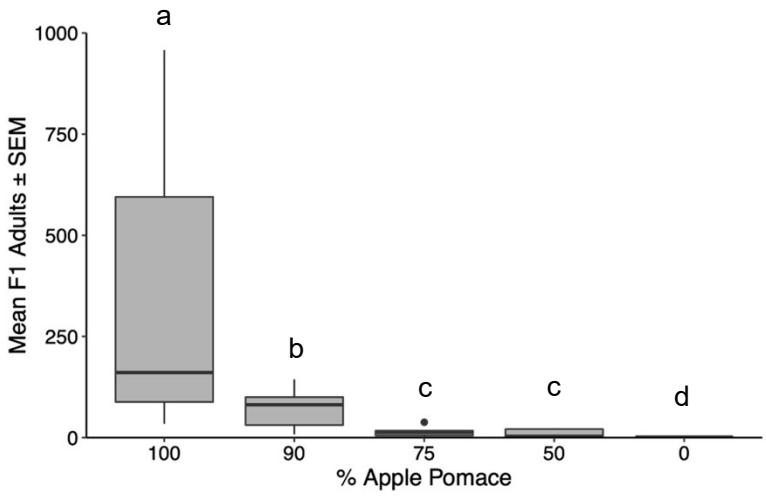
Remainder % made up of organic chicken manure

(Hooper and Grieshop 2020)

13

RESULTS

- Emergence decreased exponentially as the % apple pomace decreased
- Compared to pure pomace, emergence decreased by 95% in compost mixes containing 75% apple pomace



$F_{4, 20} = 11.29$, $p = < 0.001$, $\alpha = 0.05$

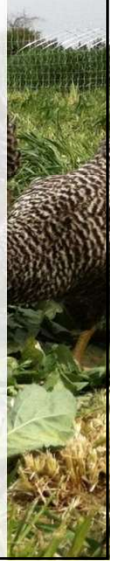
glm(emergence ~ % apple pomace, family= Poisson) in R 3.4.0.

(Hooper and Grieshop 2020)

14

CONCLUSIONS

- Mixing apple pomace with ≥ 5% chicken manure was deleterious to SWD.
- Incorporating ≥ 25% chicken manure into apple pomace eliminated it as an SWD reproductive resource.
- Other Fly species responded dissimilarly to compost treatments.
- Manure type may impact these results.



15

So why does adding chicken poop work?

- Chicken manure is high in N
  - Will synthetic N cause a similar effect to manure?
- Chicken manure likely alters waste pH
  - Will changing waste's pH change SWD reproductive success?

16

Evaluating Nitrogen Fertilizers

We know from Hooper;Grieshop 2020 that organic poultry manure will affect SWD reproduction when mixed with fruit waste (apple pomace) at a ratio of 80:20.

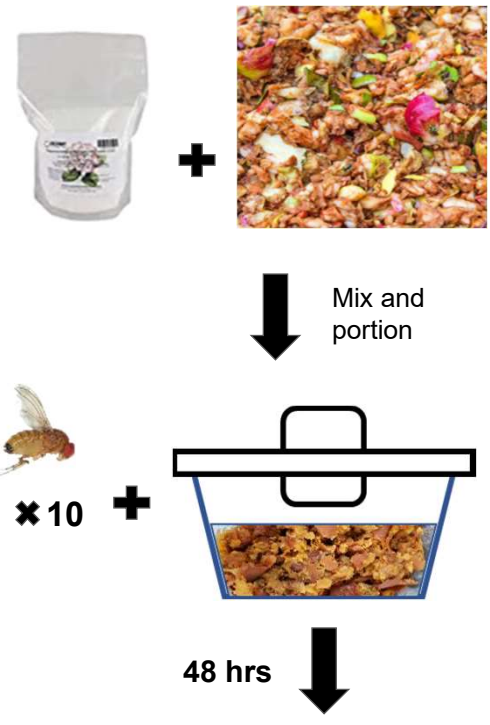
Objective: Determine if Nitrogen content specifically will affect SWD reproduction

- Nitrogen based fertilizers might provide a readily available, cost-effective option for growers which could be added to a regular spray plan, to manage SWD on post harvest waste (*we are focusing on conventional sources of N initially)

17

Methods

- Apple pomace was mixed with Nitrogen based fertilizers (Urea, Calcium Nitrate, Potassium Nitrate, Magnesium Nitrate, or Ammonium Sulfate)
- The amount of fertilizer per treatment was relative, with all treatments containing 24g N / L pomace
- 50 ml of apple pomace was placed inside individual arenas and were exposed to 10 previously mated SWD females. After 48 hours, all egg-laying females were removed.
- Once offspring emergence began, arenas were vacuumed daily to collect all adult SWD until no emergence was detected for 7 consecutive days



18

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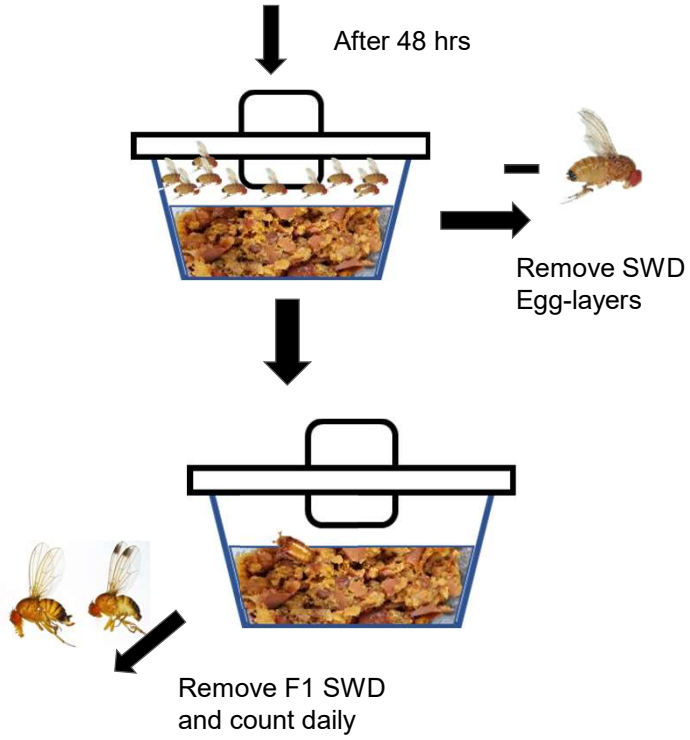

19

Observations :

Only control units visibly contained SWD eggs after the 48h lay period

20

Observations continued:

- Only control units visibly contained SWD eggs after the 48h lay period
- SWD adults only emerged from control units
- After 10 days, only the control treatments had no visible mold

21

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22

Experiment 1 : pH of waste fruit

Objective- Determine if pH of lay material (in this case, apple pomace) can be manipulated to affect SWD reproduction

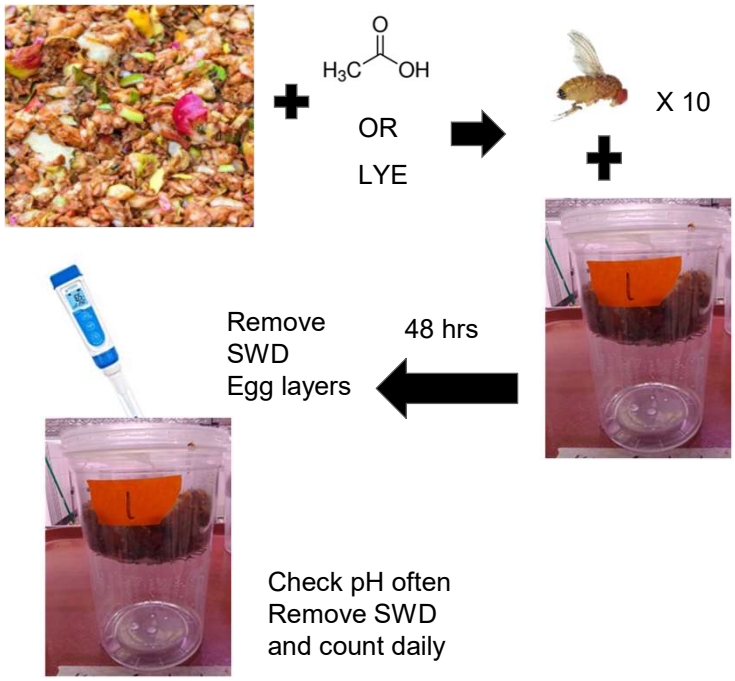
Previous research on Tephritid fruit flies has shown that RAISING pH negatively impacts larval performance

Little to no information is available for Drosophilid flies (Like SWD)

23

Methods

- 4 replicates of 5 treatments including a control
  - pH of apple pomace buffered to 3, 5.5, 6.75, or 8 control was at 4.5.
- Glacial acetic acid was used to lower pH, sodium hydroxide to increase pH
- 10 premated female SWD added and removed after 48hrs
- pH was tracked throughout the experiment
- SWD emergers removed daily and counted



24



(Roberts et al. 2008, Shalini and Gupta 2010, Maiti et al. 2018)

25

Observations

- Apple pomace buffered to pH 5.5 had a similar number of SWD adults emerge overall, as compared to the control. Pomace buffered to pH 3 had many less SWD emerge. pH 6.75 and pH 8 produced a similar number of SWD, which was still less than the control.
- pH in buffered apple pomace will stabilize over time

26

2021 Field Experiment

Hooper; Grieshop 2020 detailed the addition of organic poultry manure (20% by volume) would shut down the reproduction of SWD in apple pomace

Objectives: Determine if results of the previous Hooper experiments can be replicated in a farm-scale trial in tart cherry wastes

27

Methods

- Waste cherry piles were established at 7 sites with tart or sweet cherries as available
- Treatments: a control (just cherries), 15% organic chicken manure and 85% cherries, 25% organic chicken manure and 75% cherries, and crushed cherries
- Tents were placed on top of piles of waste fruit and insects vacuum sampled weekly, sub samples were reared out in the lab and SWD (yeast cup) traps placed around piles

28







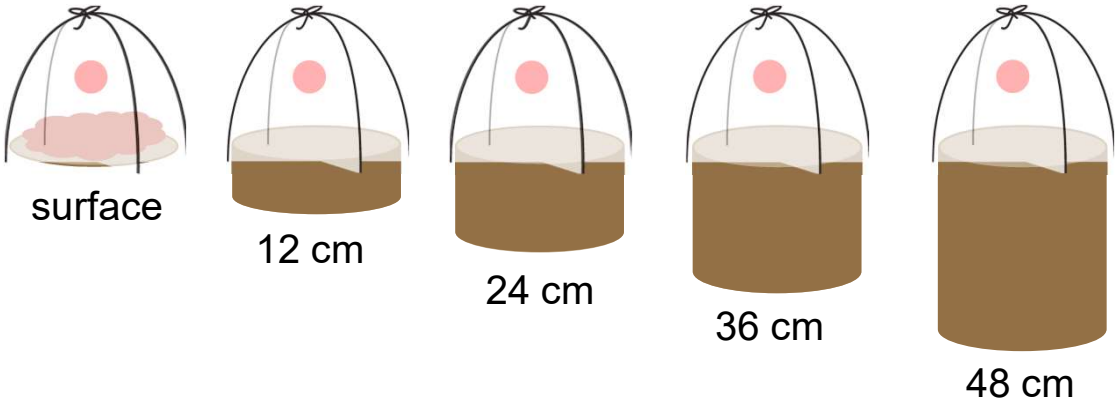

29

Observations

- Samples from the 2021 field season are still being processed
- Manure treatments affected drosophila numbers but it is still unclear as to SWD specific effects

30

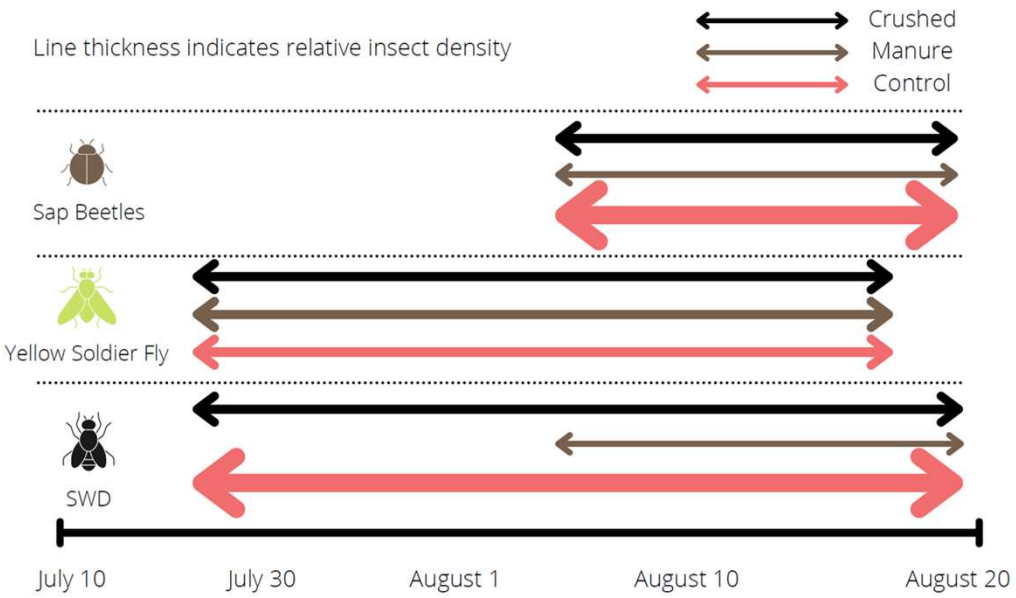
METHODS



(Hooper and Grieshop 2019)

31

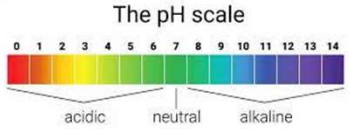
Observations continued



32

Where do we go from here?

- Nitrogen fertilizer experiments are ongoing and will continue through fall 2022
- pH levels will be taken throughout fertilizer experiments, to gather more data related to pH
- Evaluate other low pH buffers to determine if the response was to pH or vinegar (acetic acid) volatiles
- Field studies extending lab findings will continue in the 2022 (summer) field season



33

GROWER SUGGESTIONS

- Harvest ALL fruit from plants and collect dropped fruit
- Crush dropped fruit to accelerate decomposition
- Solarize waste for 48 hours in clear plastic bags
- Bury waste ≥ 10 inches below ground
- Compost waste with ≥ 25% chicken manure

34

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35

THANK YOU TO:

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36