

# Biotic and Abiotic Factors Affecting the Presence of Beneficial Insects on Oregon Christmas Tree Farms

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# Why are Christmas Trees Important?

- Oregon is the leading producer and exporter of Christmas trees in the world.
- International trading laws require pests and diseases to be eradicated before being exported.
- Insect and disease surveys are essential to Christmas tree producers and are usually conducted September to November.
- Most production farms use pesticides, but there is an overall environmental impact.

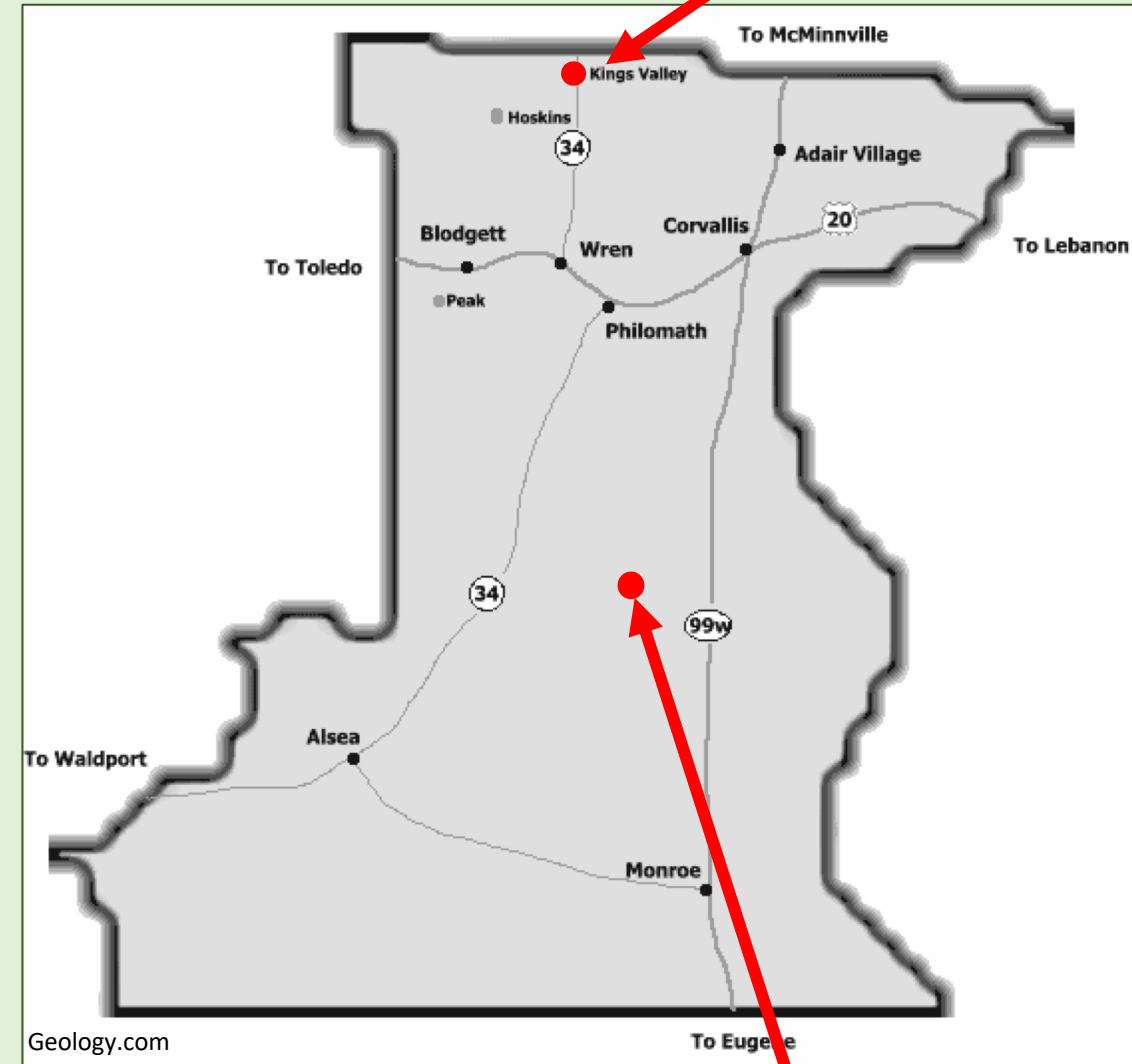


## Oregon, United States



## Benton County, Oregon

Insecticide-Free Farm  
Kings Valley, OR



Conventional Farm  
Corvallis, OR<sup>2</sup>

# The Farms:

Sunrise Farm  
(Insecticide-Free Growers)



Holiday Farms  
(Conventional Growers)



# What We Surveyed For:

- Estimated Aphid Densities
- Beneficial Insects
- Lacewing Insects



# Aphids Surveyed

## Green Peach Aphids

*Myzus persicae* Sulzer



## Balsam Twig Aphid

*Mindarus abietinus* Koch



# Why are Aphids Considered a Pest?

- Aphids feed on the phloem of the trees.
- Aphids excrete a substance called honeydew.
- Aphids can be considered a quarantine pest by many countries.





# Beneficial Insect Impact



- Prey upon aphids and other pests
- Provide Pollination Services
- Aid in decomposition



# Beneficial Insects Surveyed



## Robber Fly

(*Asilidae*)

Robber flies in their maggot and larval forms feed on aphids and other smaller pests. In their adult form feed on honeydew and pollen.



## Predatory Ground Beetle

(*Carabidae*)

Predatory ground beetles prey on aphids near the base of the tree and on lower branches, consuming up to 55 aphids/day.

# Beneficial Insects Surveyed



## Predatory Spider Mite

(*Phytoseiulus Persimilis*)

Predatory spider mites prey on aphids and other spider mites throughout the tree. (Pratt 1970)



## Ladybird Beetle

(*Coccinellidae*)

Ladybird beetles fly from tree to tree preying on aphids as adults, but are more efficient at aphid control in their larval life stage.

# Beneficial Insects Surveyed



Hoverfly  
(*Syrphidae*)

Hoverflies prey on aphids, thrips, and scales in their adult and larval stages. Ideal for aphid control because they lay eggs over a great area of land. (Ambrosino 2006)



Spider  
(*Araneae*)

Spiders spin vast webs within the trees and from tree to tree catching aphids and other flying pests such as mosquitos.



# Beneficial Insects Surveyed



## Assassin Bug

*(Reduviidae)*

Assassin bugs hide and wait to ambush their prey (aphids). Similar to lacewings and ladybird beetles, they have piercing, sucking mouthparts.



## Parasitic Wasp

*(Hymenoptera Apocrita)*

Parasitic wasps inject their eggs into the aphid's body. The larvae eat the aphid from the inside-out and then pupate near the host's body.

# Beneficial Insects Surveyed



## Native Bee

*(Hymenoptera Apoidea)*

Native bees do not necessarily prey on aphids, but clean up their honeydew. These are key indicators of aphid presence within a tree.



## Lacewing

*(Chrysoperla/ Hemerobiidae)*

Lacewings, like ladybird beetles, are predators of aphids in both adult and larval life stages. The larval stage had piercing, sucking mouthparts that are optimal for targeting aphids.

# Lacewing Insects



*Chrysoperla*



*Hemerobiidae*



# Adult

# Egg

# Larvae

# Pupae

1  
Week

1-2  
Weeks

1-1.5  
Weeks



# Abiotic Factors: Temperature



Temperature affects the abundance of aphids and beneficial insects and their emergence times.





# Abiotic Factors: Land Diversity on Farms

- Size of the Grand Fir lot surveyed.
- Total forested land adjacent to the Grand Fir lot.
- Other farms adjacent to the surveyed farm.
- Total crop area on the farm.

Importance: Insects overwinter and seek refuge in nearby fields and forests.



# Part 2: Outreach

**Functional Agricultural Biodiversity (FAB) Conference**  
March 15<sup>th</sup> , 2017  
Troutdale, Oregon



Western IPM Center

**Christmas Tree Farm Walk**

June 1<sup>st</sup>, 2017

Molalla, Oregon



# Purpose:

Determine how abiotic and biotic factors affect the populations of lacewing insects and other beneficial insects on two Oregon Christmas tree farms from May to September 2017.

# How did we do this?

- 1) Created real-time walking surveys of beneficial insect, lacewing, and estimated aphid densities.
- 2) Compared the walking survey results from a conventional Christmas tree farm to an insecticide-free farm.
- 3) Identified all naturally occurring beneficial insects on Christmas trees that prey on aphids from May to September.



# Methods and Materials

*Survey method based on protocol from  
Jana Lee USDA ARS*



Top

Middle

Bottom

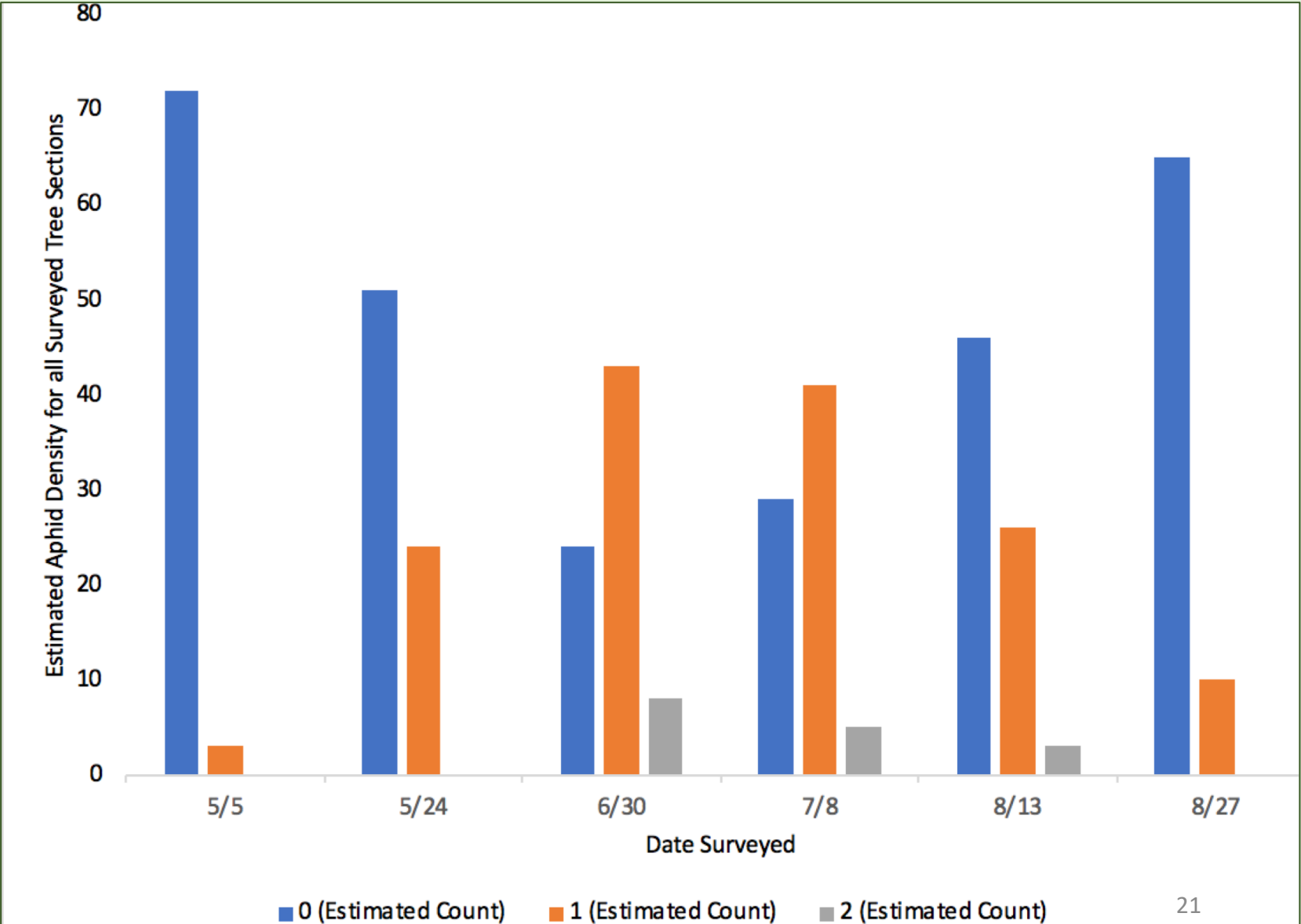




# Data: Estimated Aphid Density on the Insecticide-Free Farm

Key:

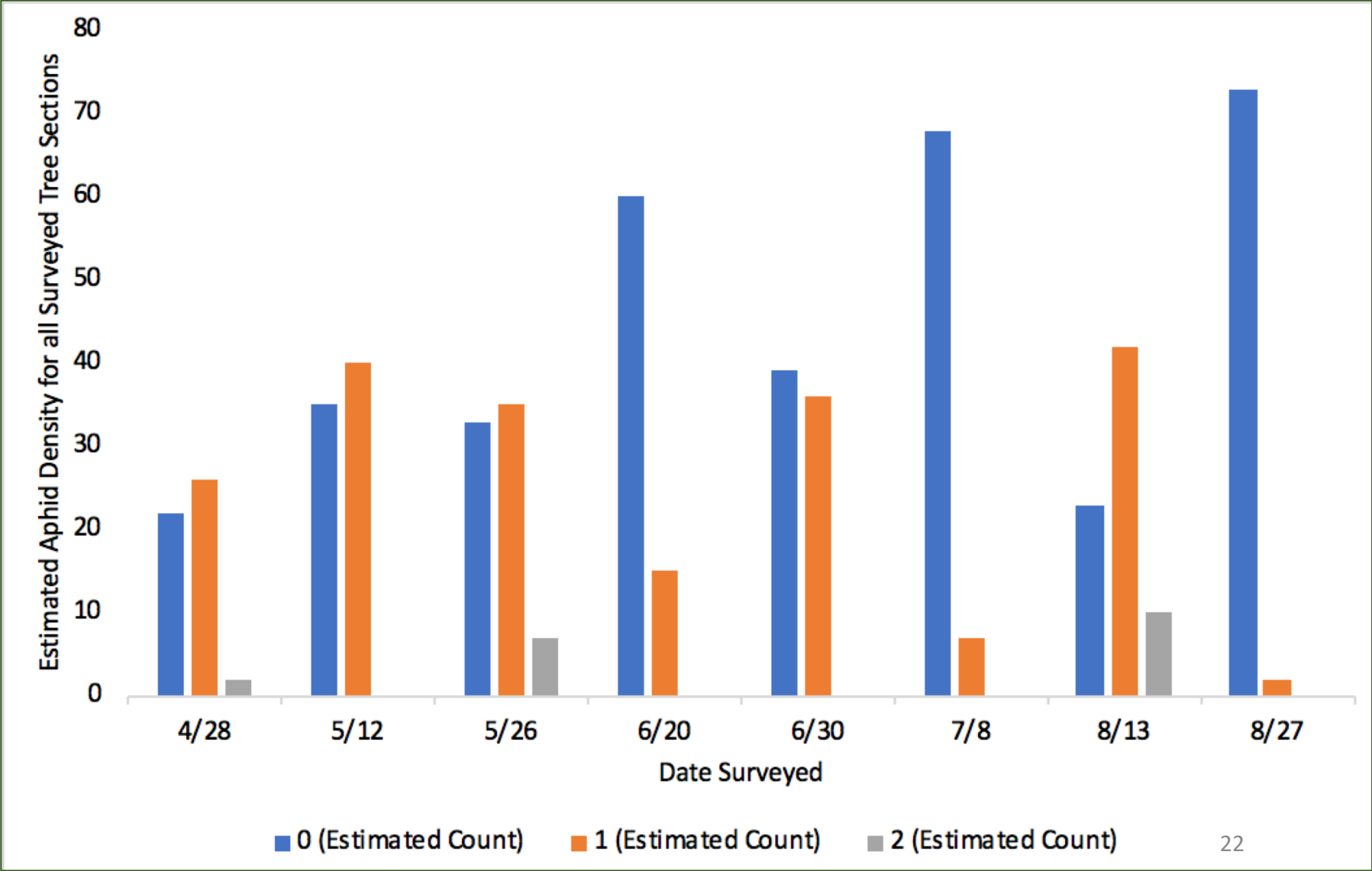
| Number listed on Figure | Estimated aphid population |
|-------------------------|----------------------------|
| 0                       | Low (0)                    |
| 1                       | Medium (1-100)             |
| 2                       | High (100+)                |



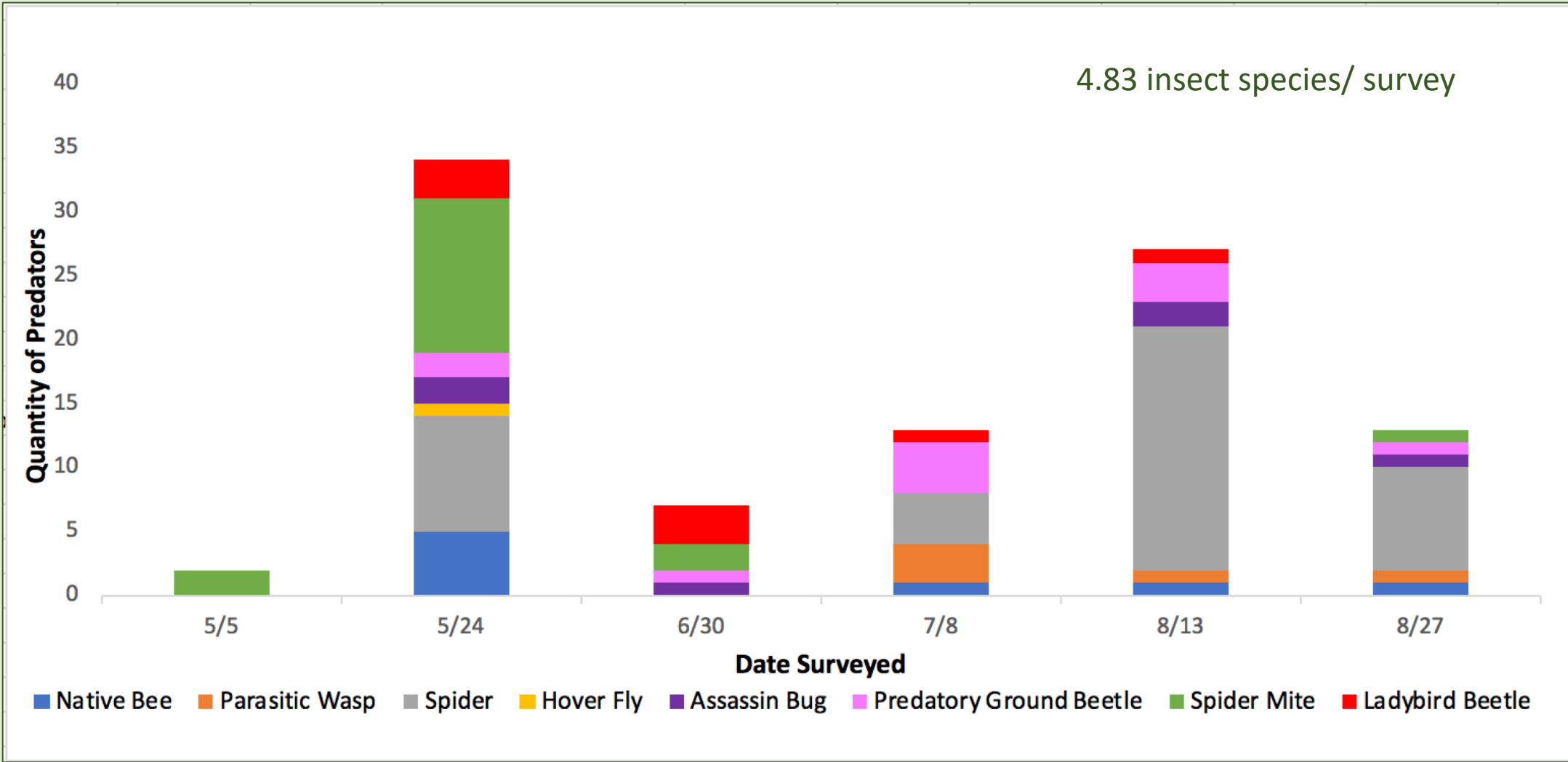
# Data: Estimated Aphid Density on the Conventional Farm

Key:

| Number listed on Figure | Estimated aphid population |
|-------------------------|----------------------------|
| 0                       | Low (0)                    |
| 1                       | Medium (1-100)             |
| 2                       | High (100+)                |



# Data: Beneficial Insect Survey from the Insecticide-Free Farm



Key:

Native Bee

Parasitic Wasp

Spider

Spider Mite

Hover fly

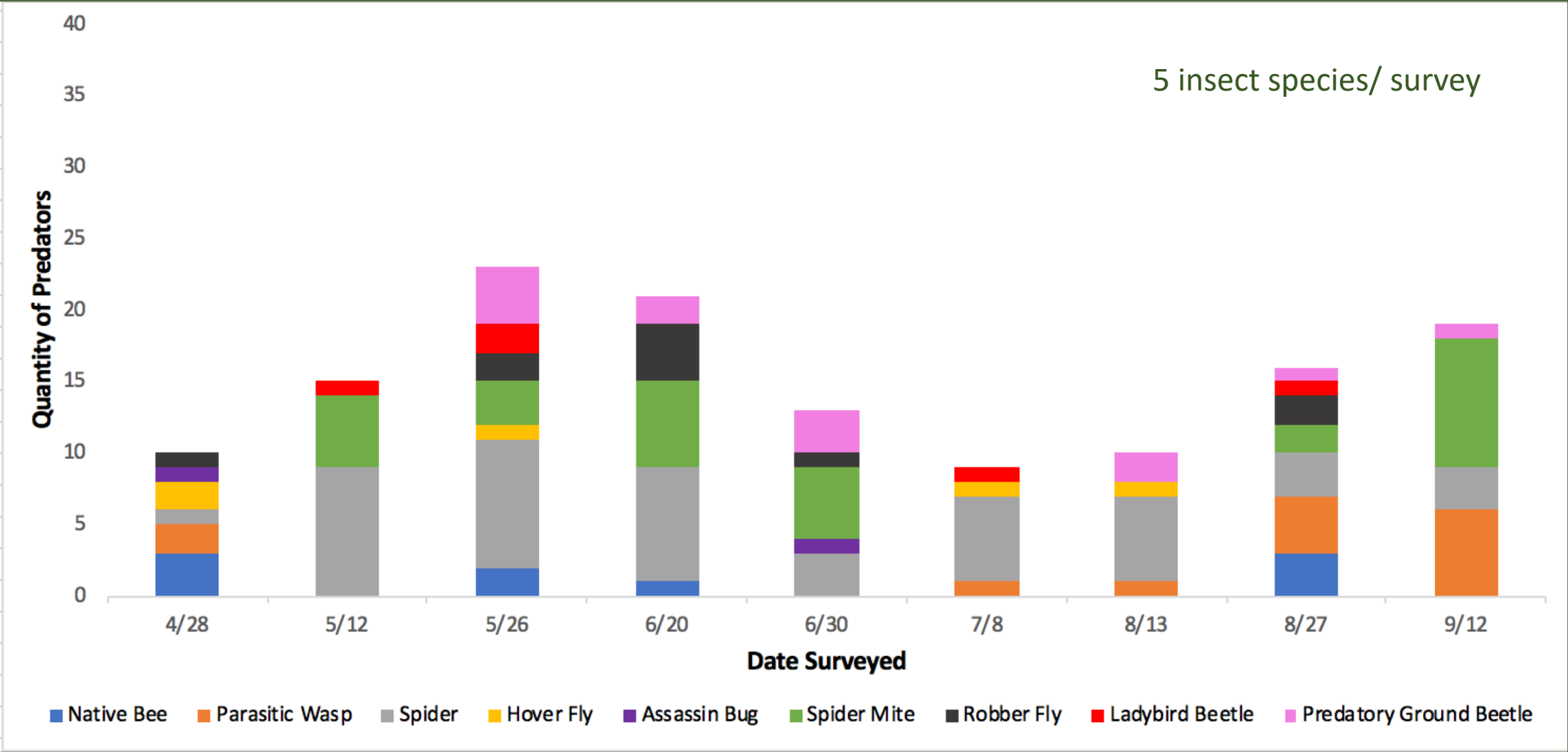
Assassin Bug

Predatory Ground Beetle

Ladybird Beetle



# Data: Beneficial Insect Survey from the Conventional Farm



Native Bee



Spider



Hover fly



Predatory Ground Beetle



Robber Fly



Parasitic Wasp



Spider Mite



Assassin Bug

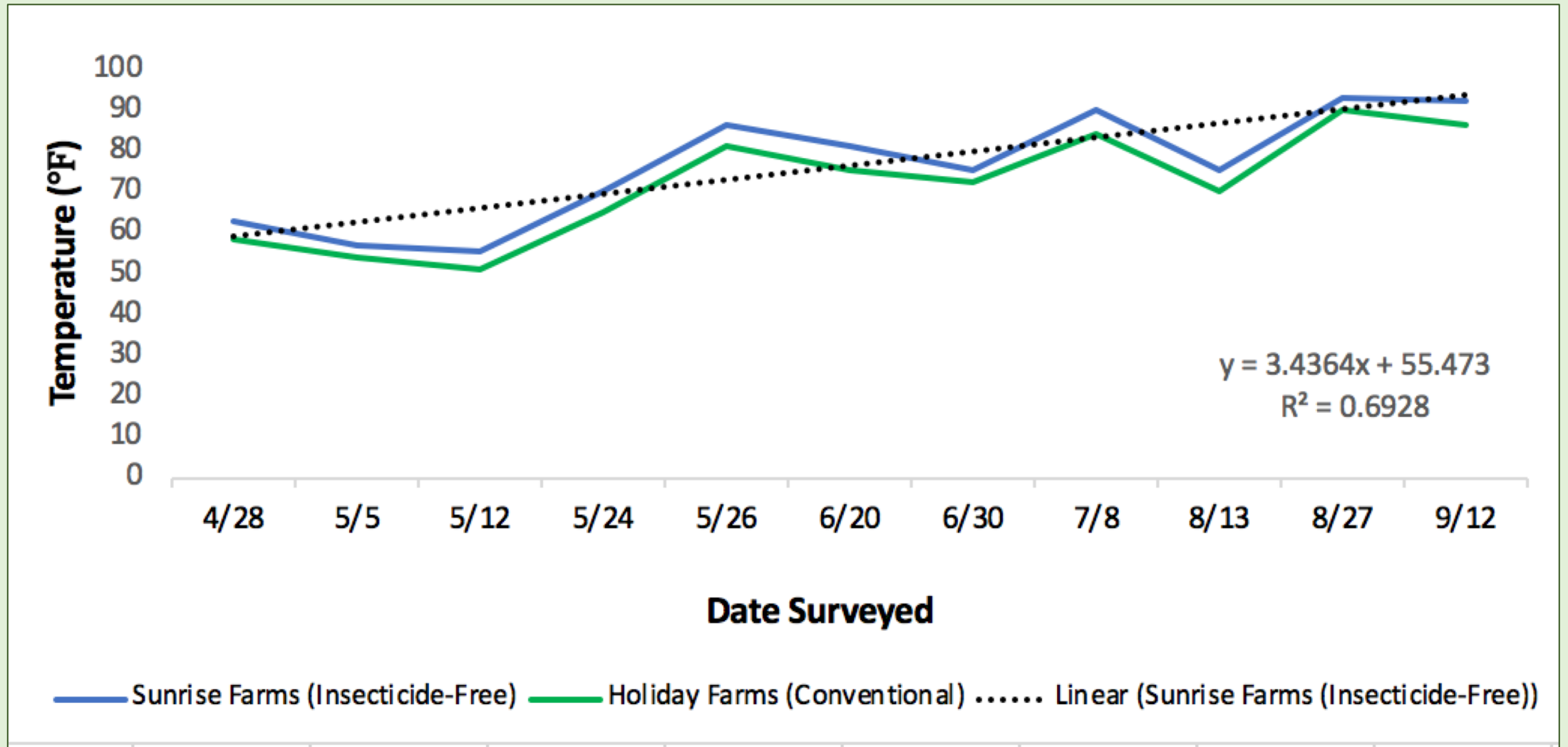


Ladybird Beetle

# Data: Total Lacewing Observances on Both Farms



# Data: Temperature Records on Both Farms





# Abiotic Factors: Land Diversity on the Insecticide-Free Farm

## Land Characteristic

- Grand Fir Lot
- Forested Area
- Surrounding Farms
- Total Crop Area





# Abiotic Factors: Land Diversity on the Conventional Farm

## Land Characteristic

- Grand Fir Lot
- Forested Area
- Surrounding Farms
- Total Crop Area



# Data: Land Characteristics

- **Total crop area** on the conventional farm was larger.
- The insecticide-free farm had a greater amount of adjacent **forested areas**.
- There were more **neighboring farms** at the insecticide-free farm.
- **Grand fir lots** on both farms were not drastically different in size.

| Land Characteristic               | Insecticide-Free Farm | Conventional Farm |
|-----------------------------------|-----------------------|-------------------|
| Grand Fir Lot (m <sup>2</sup> )   | 7.4406                | 32.536            |
| Forested Area (m <sup>2</sup> )   | 407.76                | 408.64            |
| Nearby Farms (m <sup>2</sup> )    | 185.89                | 133.37            |
| Total Crop Area (m <sup>2</sup> ) | 369.92                | 973.32            |



# Results Summarized

1. A greater richness of beneficial insects were found on the farm that was insecticide-free.
2. Spiders were the beneficial insect found in abundance.
3. If the estimated aphid density was low, beneficial insects were observed in abundance to control those populations.

# Results Summarized (Continued)

1. Lacewing insects were not found in abundance on either farm.
2. Temperature fluctuations may have caused population fluctuations of both beneficials and aphid populations.
3. The insecticide-free farm had a greater amount of adjacent habitat and more predators present on their trees.

# Conclusion

- The surveys conducted are just a snapshot of the ecological timeline on each farm.
- The pesticide-free farm allowed for a stable population of beneficial insects to control aphids.
- A broad array of beneficial insects were present on both farms.
- With Christmas trees being a big commodity in Oregon, pesticide usage will have a large environmental impact.
- **Most importantly: Farmers are more aware of all the insects present on their farm.**



# Issues Experienced during the Surveys

- Communication with farmers, due to it being a working farming system.
- Differing weather on each farm.
- Working around:
  - Blackberries in between trees at Holiday (conventional) Farms
  - Bald-faced hornets within trees at Sunrise (insecticide-free) Farms

# Future Research

- Consistent parameters for surveys across farms such as:
  - Area of land surveyed
  - Days elapsed between surveys
- Different coniferous tree sampled.
- Taking data over a longer period of time.
- Survey more Oregon Christmas Tree farms.



# Acknowledgements

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- The Malone family at Sunrise Farms and Dave Silen at Holiday Farms for allowing me to conduct insect surveys.
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