Utah Department of Agriculture and Food

Specialty Crop Pollinator Health Survey

Tree Fruit and Berry Pollinator Health Survey — Year 2 Report

Abstract

The Utah Department of Agriculture and Food (UDAF) is conducting a multi-year survey of honey bee health in tree fruit and berry growing areas of Utah. The second year of data has been collected and is presented here.

Introduction

Honey bees are key pollinators of eight different tree fruits, which are grown by over 300 operations on approximately 7,000 acres in the State of Utah (NASS, 2007). There are also approximately 50 berry growers in the state (USU 2006). The products from these operations yield over $17 million annually. Many berries are self-pollinating, but these crops cannot reach maximum yield without pollinators. These industries require increased pollination services, yet honey bee health has been on the decline for decades (Kaplan, 2013). In 2014, UDAF began a two-year state-wide survey of honey bee colonies. The overall purpose of both surveys is to evaluate the health of beehives in fruit growing areas of the state. Specific objectives outlined include:

- **Primary objective**: Establish a baseline level of American foulbrood (*Paenibacillus larvae*) in sampled counties.
- **Secondary objective**: Evaluate the general health of hives and monitor for exotic predators of honey bees in sampled apiaries.
- **Tertiary objective**: Increase tree fruit and berry growers' abilities to maximize pollination of their crops and improve beekeepers' understanding of honey bee diseases and pests.

Methodology

The survey was conducted statewide, but it heavily sampled Box Elder, Davis, Utah and Washington counties. UDAF contacted and arranged inspections with most of the participants. Data was also collected from beekeepers that requested an inspection from the department. Beekeepers were asked management questions, such as whether their apiary had increased, decreased or stayed the same size over the last year.

Inspection Protocol

Hives were surveyed for evidence of diseases and pests. Three frames of brood were inspected in each colony for the diseases American foulbrood, European foulbrood (*Melissococcus plutonius*), chalkbrood (*Ascosphaera apis*), stonebrood (*Aspergillus spp*.) and sacbrood virus. A powdered sugar roll was performed on each hive inspected to estimate Varroa mite (*Varroa destructor*) loads. If a hive was dead, weak or exhibiting slow build up, a sample of adult bees was taken for Nosema (*Nosema apis; Nosema ceranae*) testing. Colonies were also inspected for the presence of exotic honey bee pests, such as small hive beetle (*Aethina tumida)* and Tropilaelaps mites (*Tropilaelaps clareae; T. mercedesae*). If the apiary had 20 or fewer hives, all colonies were inspected (time permitting). If the apiary had more than 20 hives, either 10% of hives were inspected or five hives were examined, whichever was greater.

Data Interpretation

Compared to many other bees, honey bees can forage extremely long distances. However the maximum foraging distance of the honey bee tends to not exceed four miles (Hagler et al. 2011; Beekman and Ratnieks 2000). Therefore a beehive inspected within a four mile radius of an orchard was considered to be in a "fruit growing buffer," whereas any colony more than four miles away was categorized as "outside a fruit growing buffer." This distinction was made in order to make a comparison of health between honey bees which may be pollinating orchards and those which are not providing specialty crop pollination.

Results

In 2015, 184 apiaries containing 854 hives were inspected for the survey. 276 of those colonies were in fruit growing areas and 486 colonies were outside of fruit growing areas and 92 were inside berry growing areas. The survey did not detect the Tropilaelaps mite or the small hive beetle.

Compared to the previous year, roughly 48% of apiaries surveyed inside the fruit buffer increased in size, 41% of apiaries inside the berry buffer added colonies and about 50% of apiaries outside fruit or berry growing areas expanded. In relation to the size of the apiaries in the previous year, 16% of the apiaries in the fruit buffer shrank, 22% of beeyards in the berry buffer decreased in size and about 13% of those hives kept outside either buffer were smaller. The percentages of apiaries that stayed the same size were nearly the same within and outside the buffers. Numerous honey bee diseases were field diagnosed and lab confirmed.

American foulbrood

Three colonies were found infected with American foulbrood. As a percentage of those inspected, less than 0.5% of colonies in the fruit buffer or outside the buffer were infected. No cases of American foulbrood were found in the berry buffer. The Apiary Program's goal is to keep American foulbrood below 1% statewide.

Nosema

Due to constraints of the survey's budget, Nosema (*Nosema apis; Nosema ceranae*) testing was not performed at all apiaries. Instead, adult bee samples were taken from hives that were weakened, dead or demonstrating overt symptoms of the disease. A total of 194 colonies were sampled for testing. There was not a statistically significant difference between the prevalence of Nosema in any of the buffers. The Nosema-positive data was divided into two groups: above one million spores per bee and below one million spores per bee. This division was made because the economic action threshold (the point at which a treatment should be administered) for *Nosema apis* is one million spores per bee (El-Shemy and Pickard, 1989).

Colonies within the tree fruit buffer area that were dead, weak or exhibiting slow build up:

- Roughly 9% had spore load averages above one million per bee

- Approximately 16% had spore load averages below one million per bee
- In total, nearly 24% of bees had some level of infection

Colonies in the berry buffer area that were dead, weak or exhibiting slow build up:

- 3% of colonies had spore load averages above one million per bee
- 6% percent of colonies had spore load averages below one million per bee
- 9% percent of colonies had some level of infection

Colonies outside the buffer area that were dead, weak or exhibiting slow build up:

- Around 10% demonstrated spore load averages above one million per bee
- Almost 9% had spore load averages below one million spores per bee.
- About 18% of hives had some level of infection.

Varroa Mite and Parasitic Mite Syndrome

The Apiary Program recommends that hobbyist beekeepers do not let their mite load reach 5% of the population of honey bees in the colony and that commercial beekeepers keep their mite load from exceeding 3% of the honey bees in the colony. The average mite load exceeded these thresholds in all of the buffers. In the tree fruit buffer the average load was nearly 9% of the bee population. The berry buffer area exhibited the highest mite infestations, with hives averaging 12%. Areas outside both buffers were found to have the lowest percentage of mites (almost 7%), but were nonetheless excessively infested.

The level of parasitic mite syndrome, a condition associated with severe mite stress, was approximately 4% of colonies inside the tree fruit buffer. This malady was found at more than double the rate in hives inside the berry buffer (10%). Outside both buffers, parasitic mite syndrome was diagnosed in roughly 4% of hives.

Other maladies

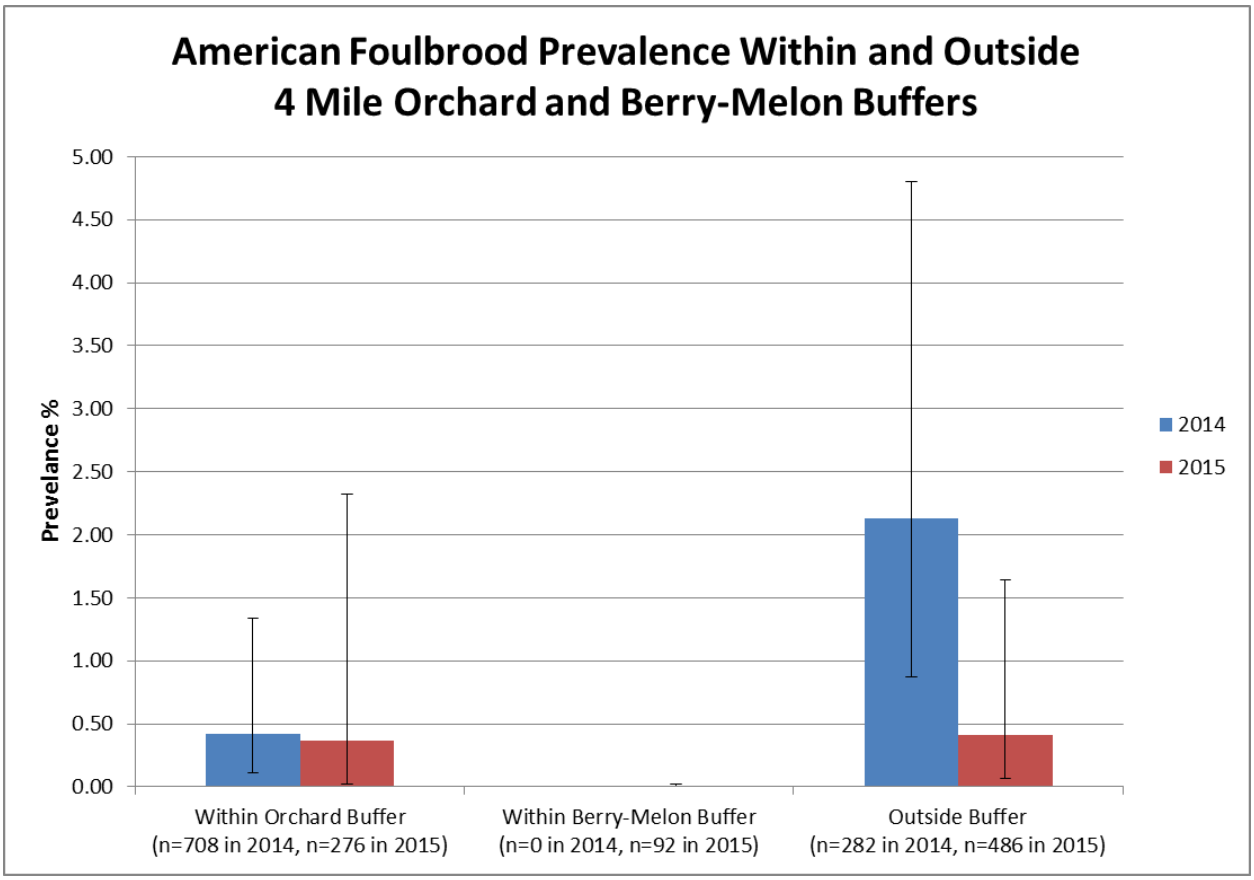
European foulbrood was detected in more than 1% of hives in both the tree fruit and berry buffer. This disease was found in less than 1% of colonies in areas outside of the buffer. Chalkbrood was highest in areas where berries were grown; about 3% of colonies in these areas were infected. Tree fruit areas had this disease at a slightly lower rate (2.5%). Areas outside of tree fruit and berry growing areas had the lowest infection rate (1.5%).

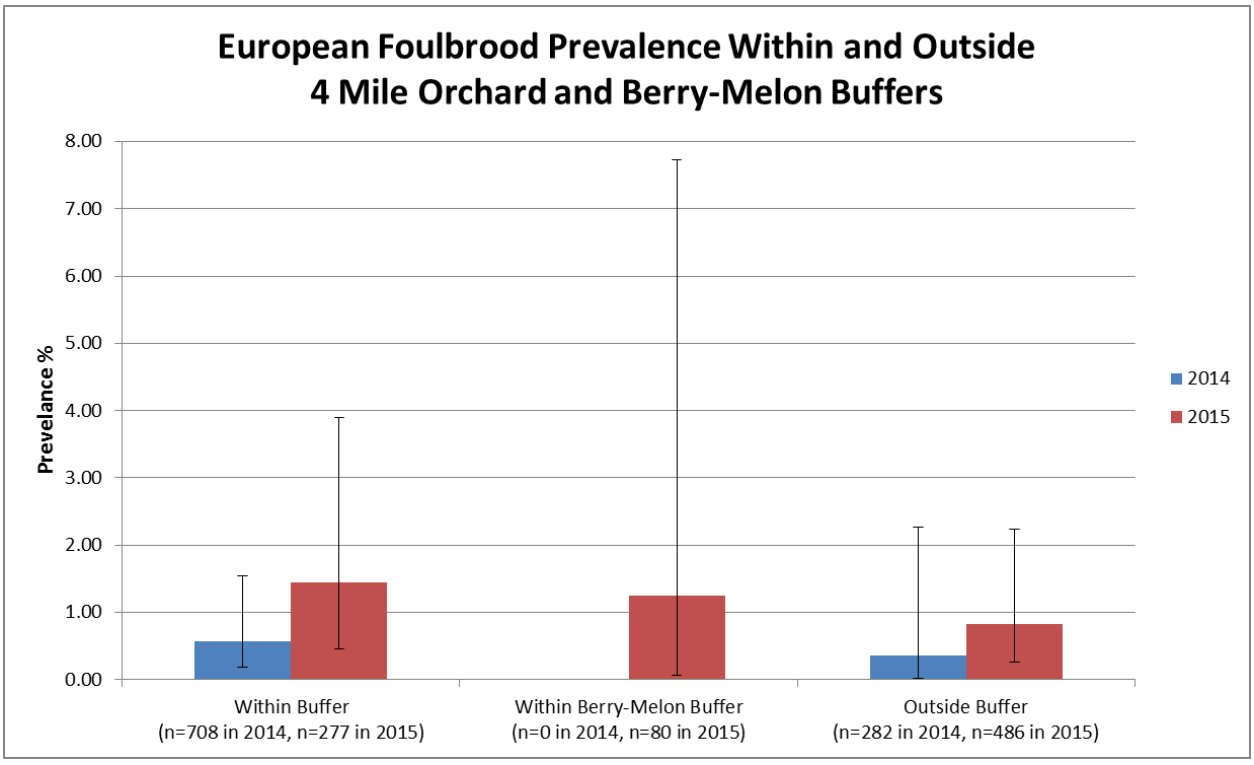
Discussion

The prevalence of American foulbrood was below 1% of colonies surveyed in all areas. The department's goal is to keep American foulbrood below the level of 1% of colonies statewide. This is because at a 1% rate, the disease is being created at quickly as cases are being eliminated or treated (Goodwin and Eaton 1999). If the rate exceeds 1%, then the disease will likely proliferate; if the rate is below 1% then it can be contained.

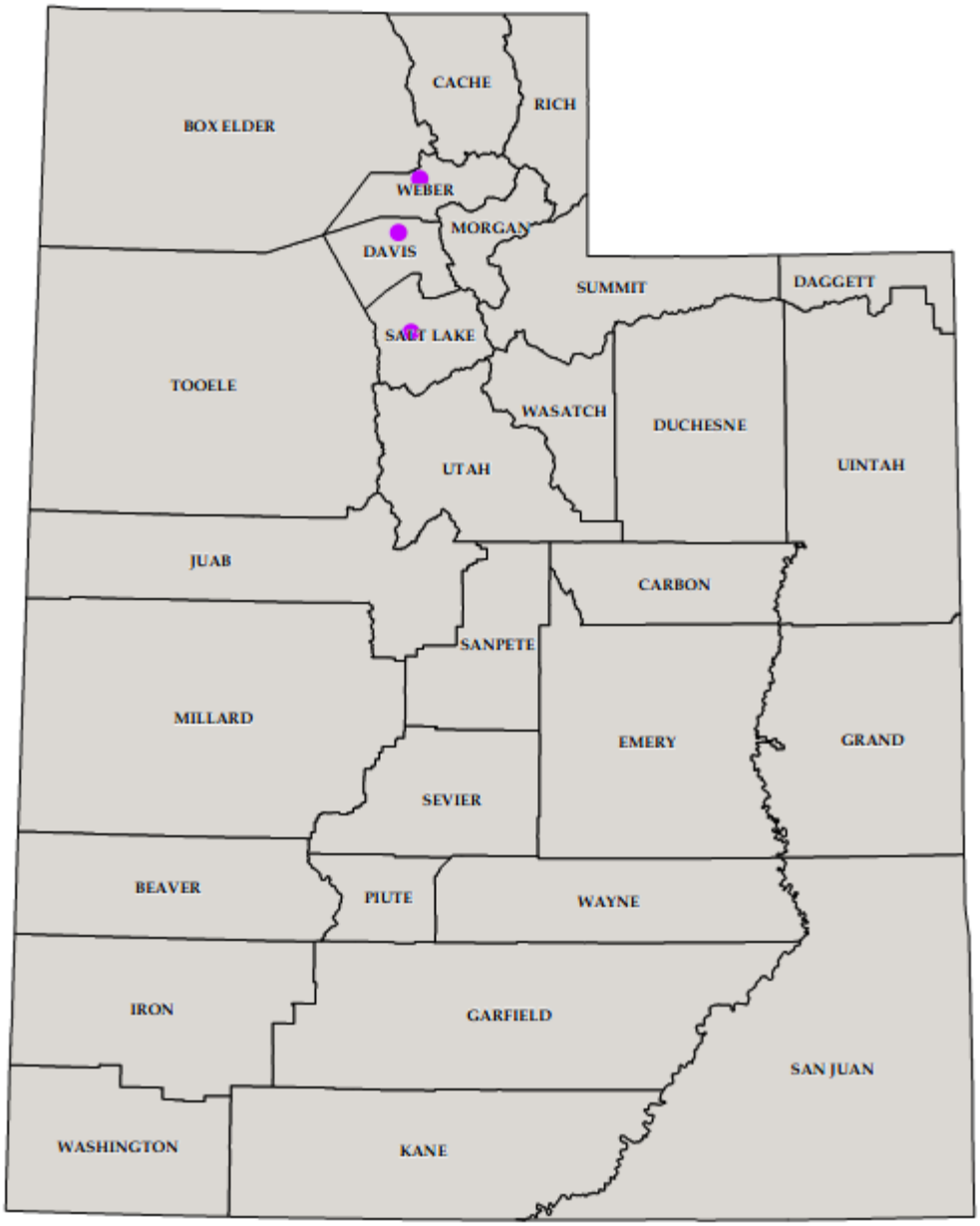
There appeared to be little difference between disease incidence when comparing data from within the buffer and outside the buffer. Indeed when comparing apiaries within the tree fruit buffer, berry buffer and outside either buffer, the measured rate of maladies was within the confidence intervals.

Despite the subtle variances in disease occurrence, there were statistically significant differences between the Varroa mite infestations, when comparing the different buffer areas. The average Varroa mite loads were in excess of the Apiary Program's recommended levels in all buffer areas; berry fruit growing areas had the highest Varroa mite infestations. The excessive infestations of Varroa mites in all areas likely have a significant negative impact on honey bee health in Utah.

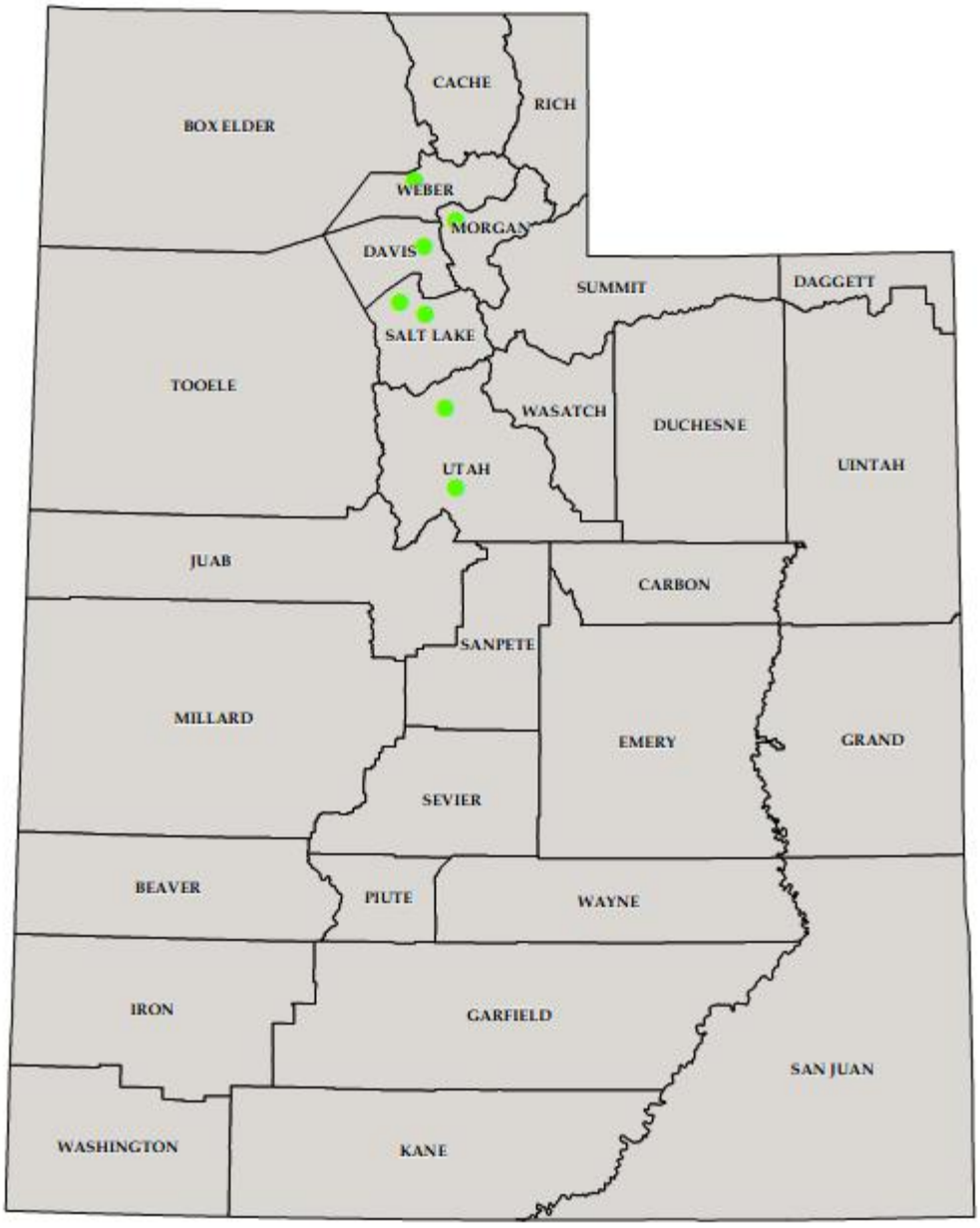

American Foulbrood Prevelance Within and Outside 4 Mile Orchard and Berry-Melon Buffers
Prevelance %
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
2014
2015
Within Orchard Buffer (n=708 in 2014, n=276 in 2015)
Within Berry-Melon Buffer (n=0 in 2014, n=92 in 2015)
Outside Buffer (n=282 in 2014, n=486 in 2015)

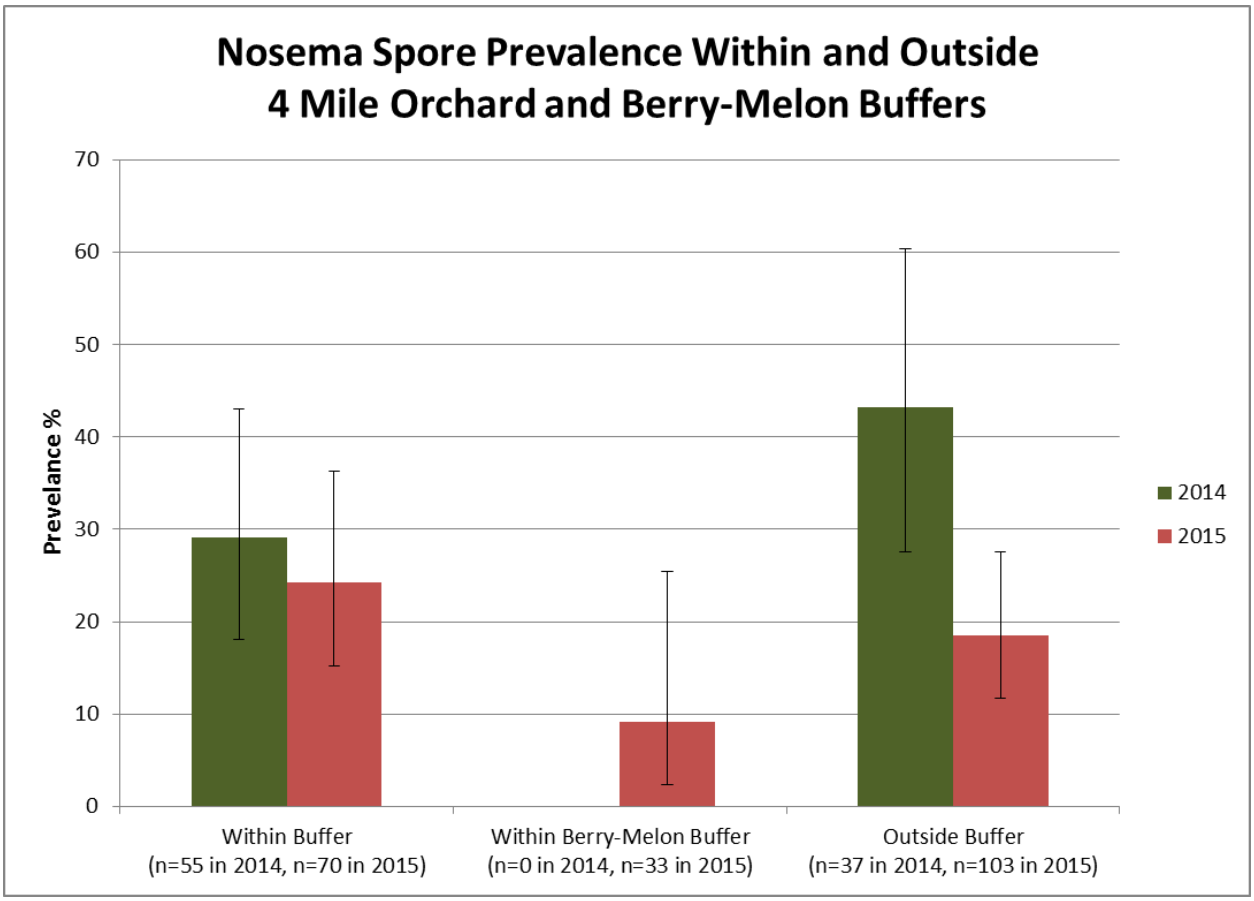

European Foulbrood Prevelance Within and Outside 4 Mile Orchard and Berry-Melon Buffers
Prevelance %
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
2014
2015
Within Buffer (n=708 in 2014, n=277 in 2015)
Within Berry-Melon Buffer (n=0 in 2014, n=80 in 2015)
Outside Buffer (n=282 in 2014, n=486 in 2015)

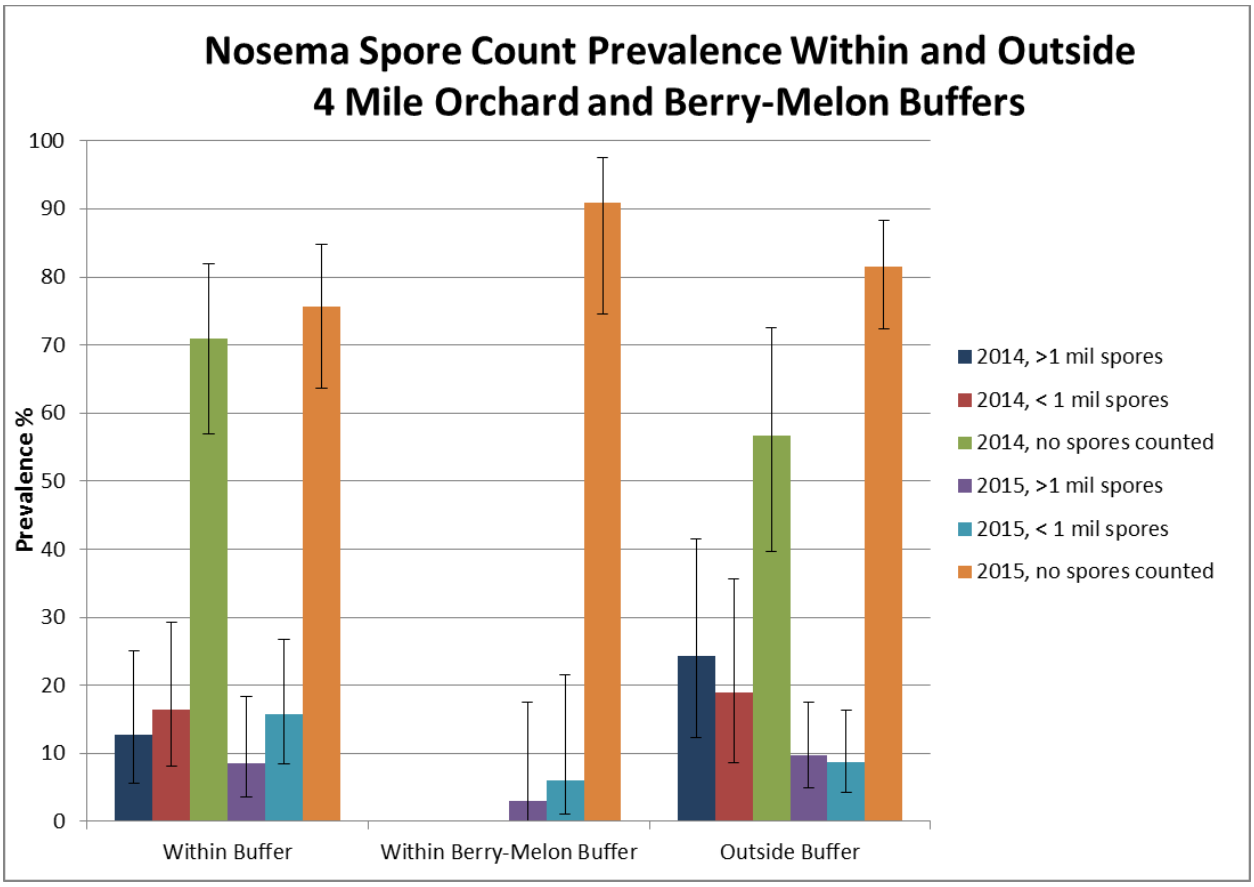
American Foulbrood Cases in Utah 2015

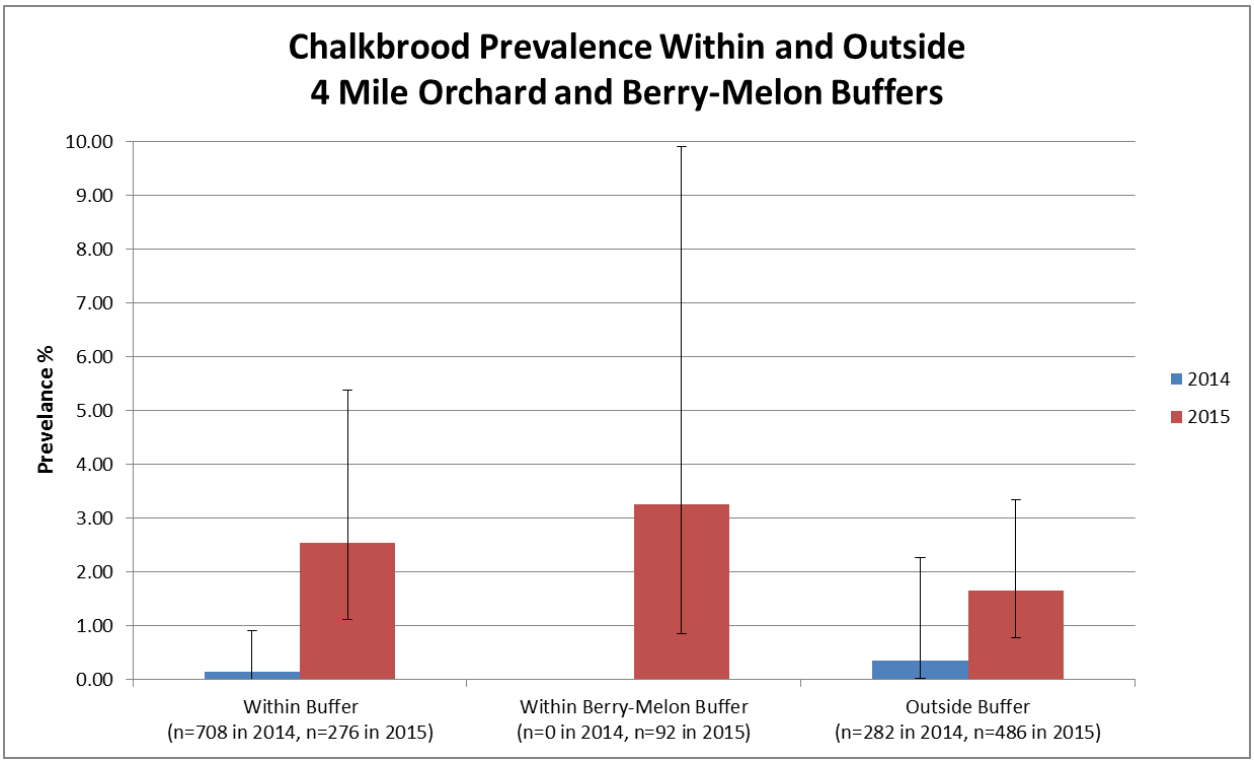


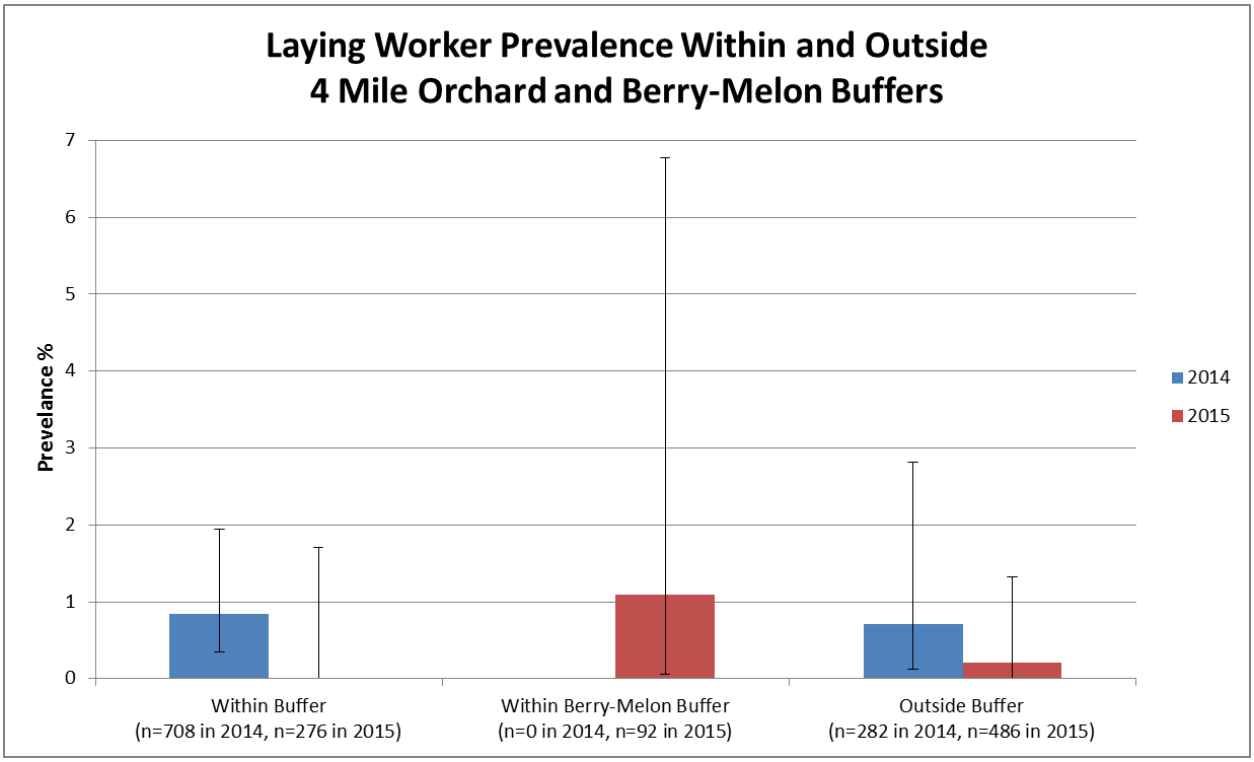
European Foulbrood Cases in Utah 2015



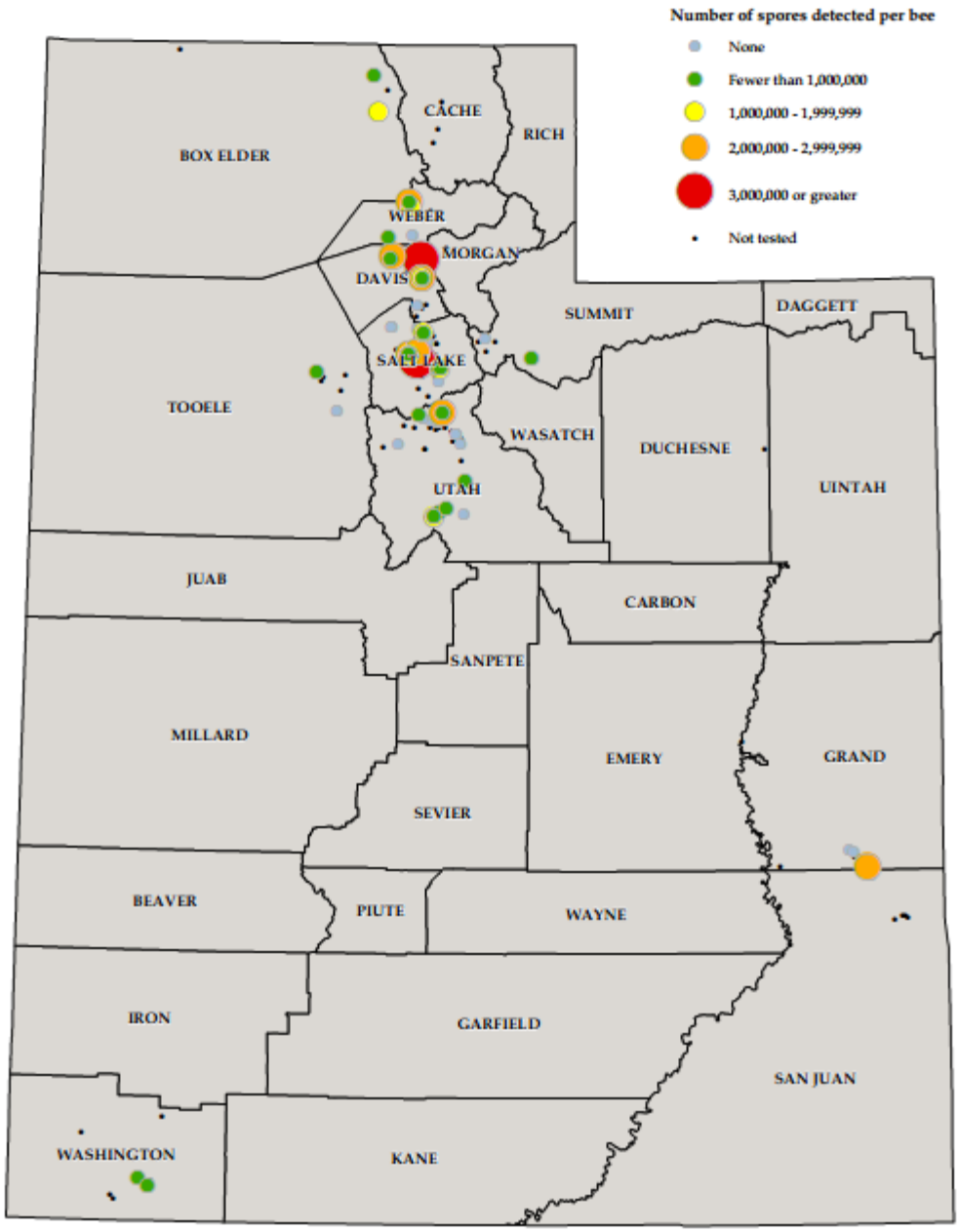

Nosema Spore Prevalence Within and Outside 4 Mile Orchard and Berry-Melon Buffers
Prevelance %
70
60
50
40
30
20
10
0
2014
2015
Within Buffer (n=55 in 2014, n=70 in 2015)
Within Berry-Melon Buffer (n=0 in 2014, n=33 in 2015)
Outside Buffer (n=37 in 2014, n=103 in 2015)


Nosema Spore Count Prevalence Within and Outside 4 Mile Orchard and Berry-Melon Buffers
Prevalence %
100
90
80
70
60
50
40
30
20
10
0
2014, >1 mil spores
2014, < 1 mil spores
2014, no spores counted
2015, >1 mil spores
2015, < 1 mil spores
2015, no spores counted
Within Buffer
Within Berry-Melon Buffer
Outside Buffer

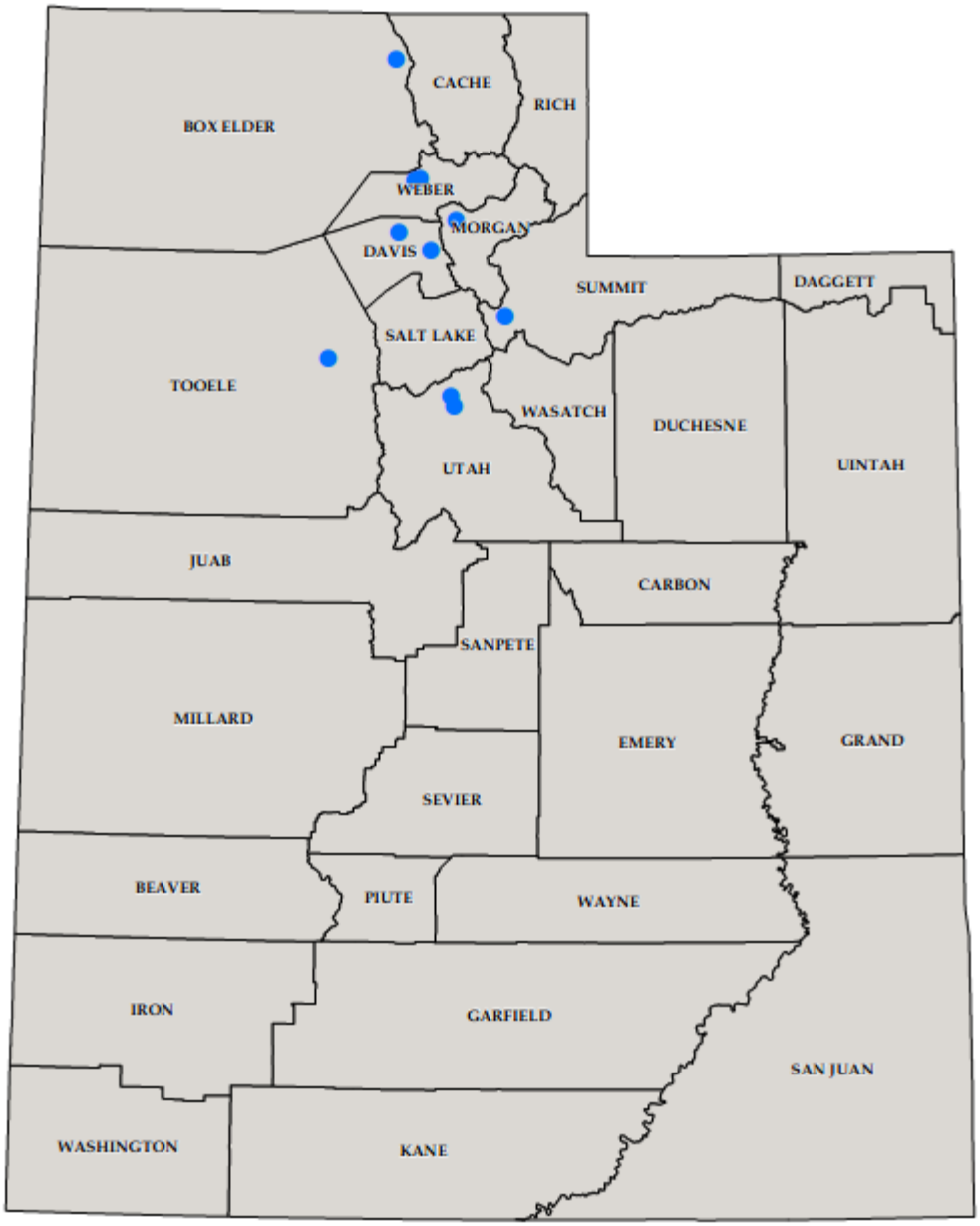

Chalkbrood Prevalence Within and Outside
4 Mile Orchard and Berry-Melon Buffers
Prevelance %
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
2014
2015
Within Buffer
(n=708 in 2014, n=276 in 2015)
Within Berry-Melon Buffer
(n=0 in 2014, n=92 in 2015)
Outside Buffer
(n=282 in 2014, n=486 in 2015)

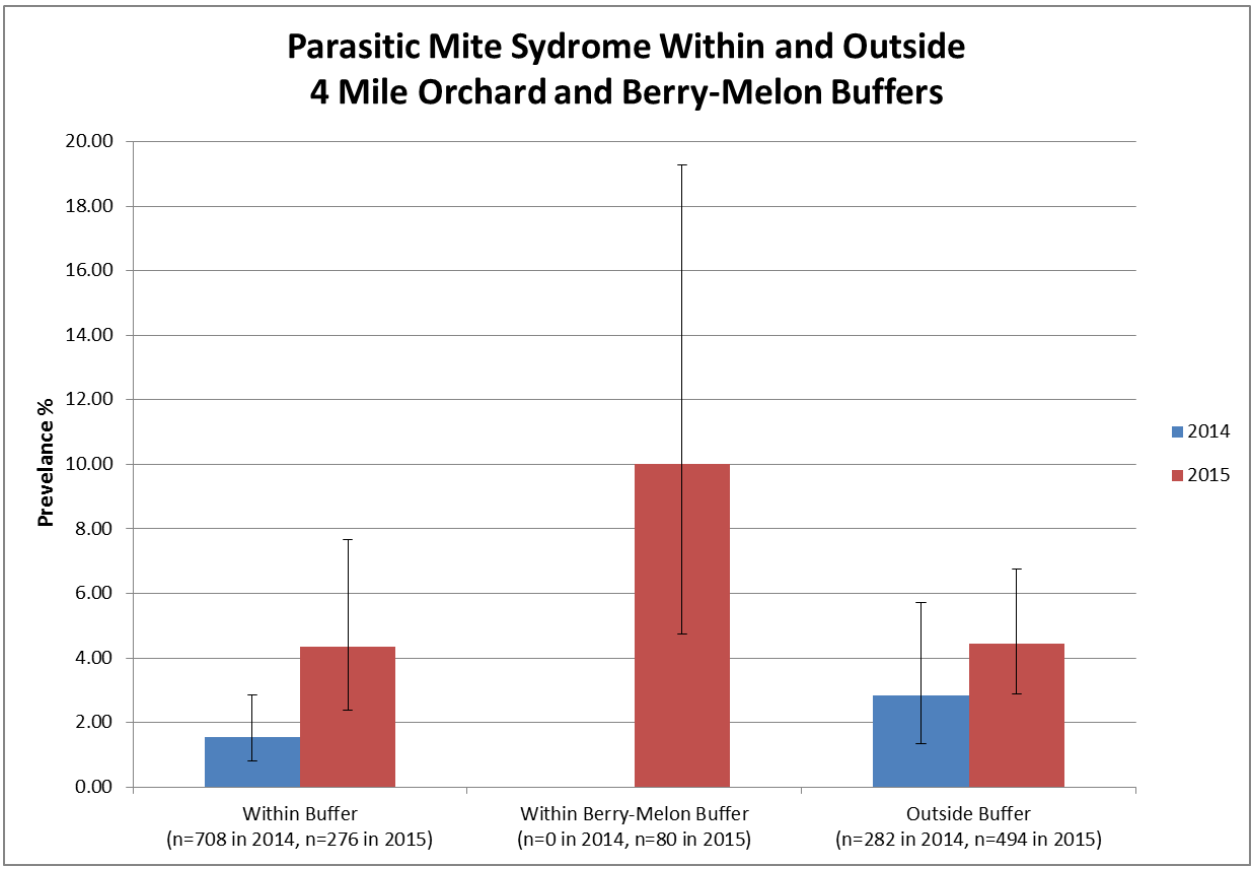

Laying Worker Prevalence Within and Outside
4 Mile Orchard and Berry-Melon Buffers
Prevelance %
7
6
5
4
3
2
1
0
2014
2015
Within Buffer
(n=708 in 2014, n=276 in 2015)
Within Berry-Melon Buffer
(n=0 in 2014, n=92 in 2015)
Outside Buffer
(n=282 in 2014, n=486 in 2015)

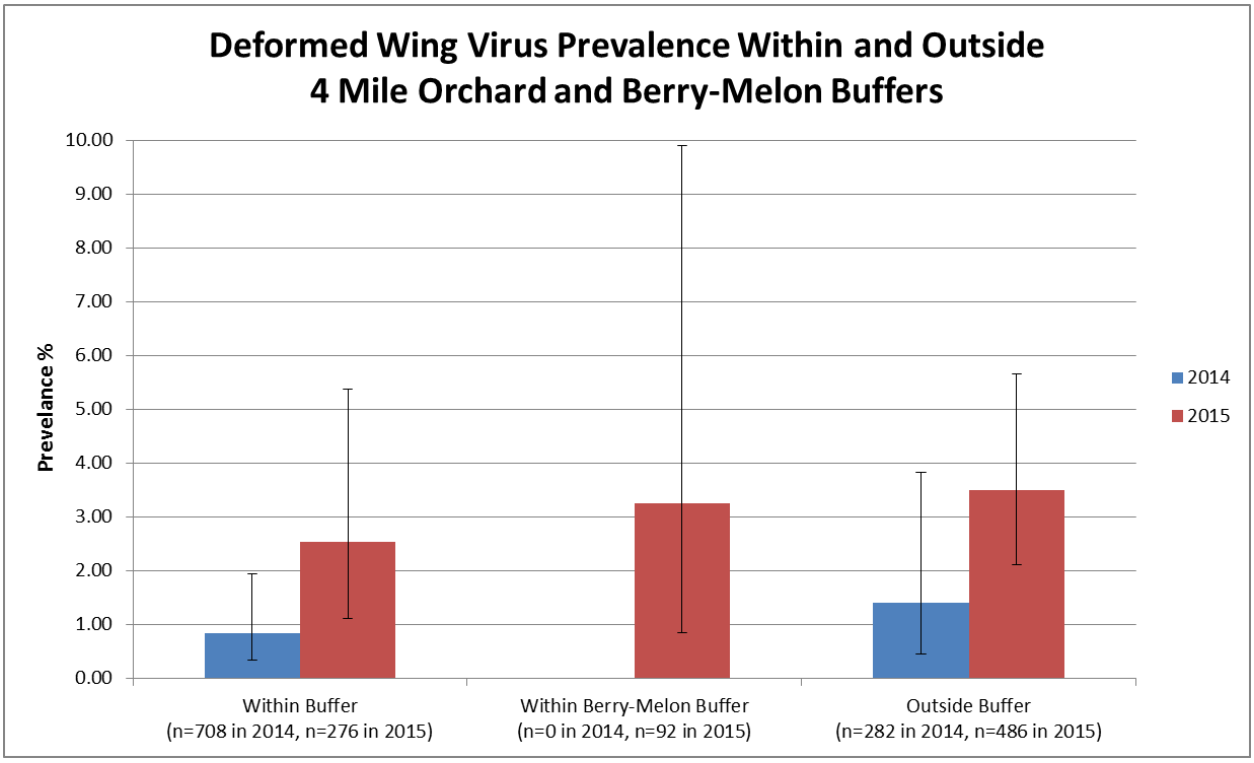
Nosema Cases in Utah 2015



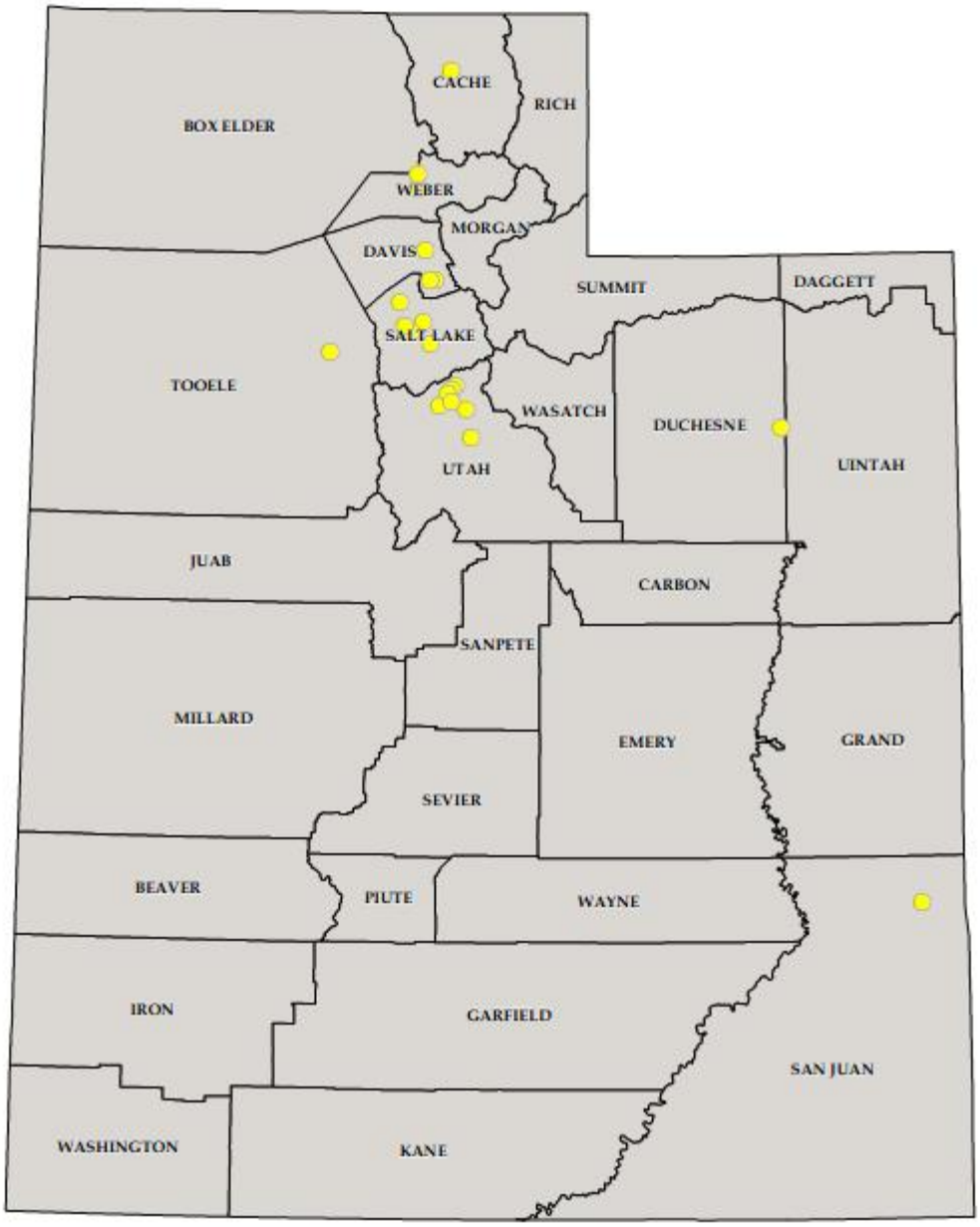
Chalkbrood Cases in Utah 2015



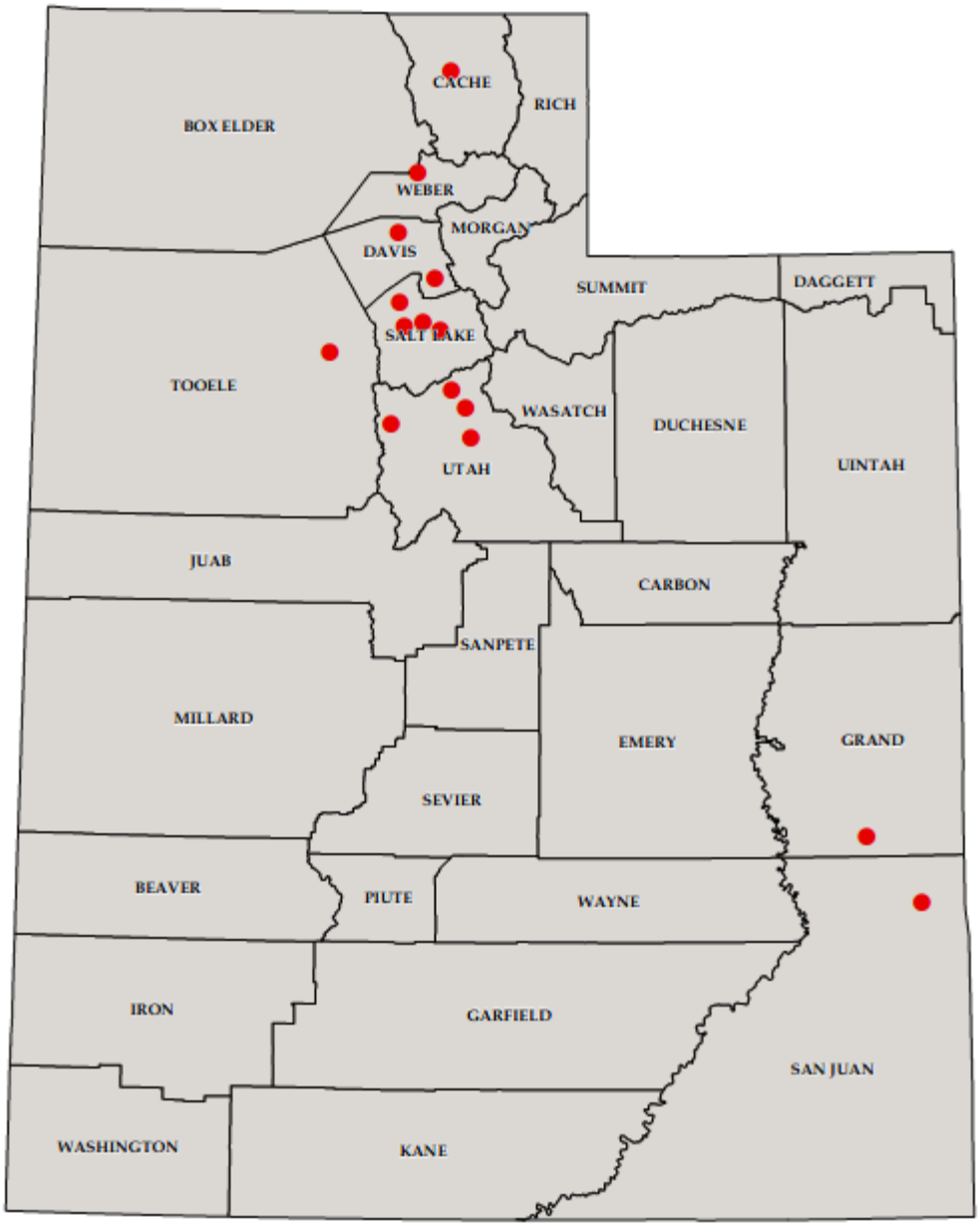

Parasitic Mite Sydrome Within and Outside
4 Mile Orchard and Berry-Melon Buffers
Prevelance %
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
2014
2015
Within Buffer
(n=708 in 2014, n=276 in 2015)
Within Berry-Melon Buffer
(n=0 in 2014, n=80 in 2015)
Outside Buffer
(n=282 in 2014, n=494 in 2015)

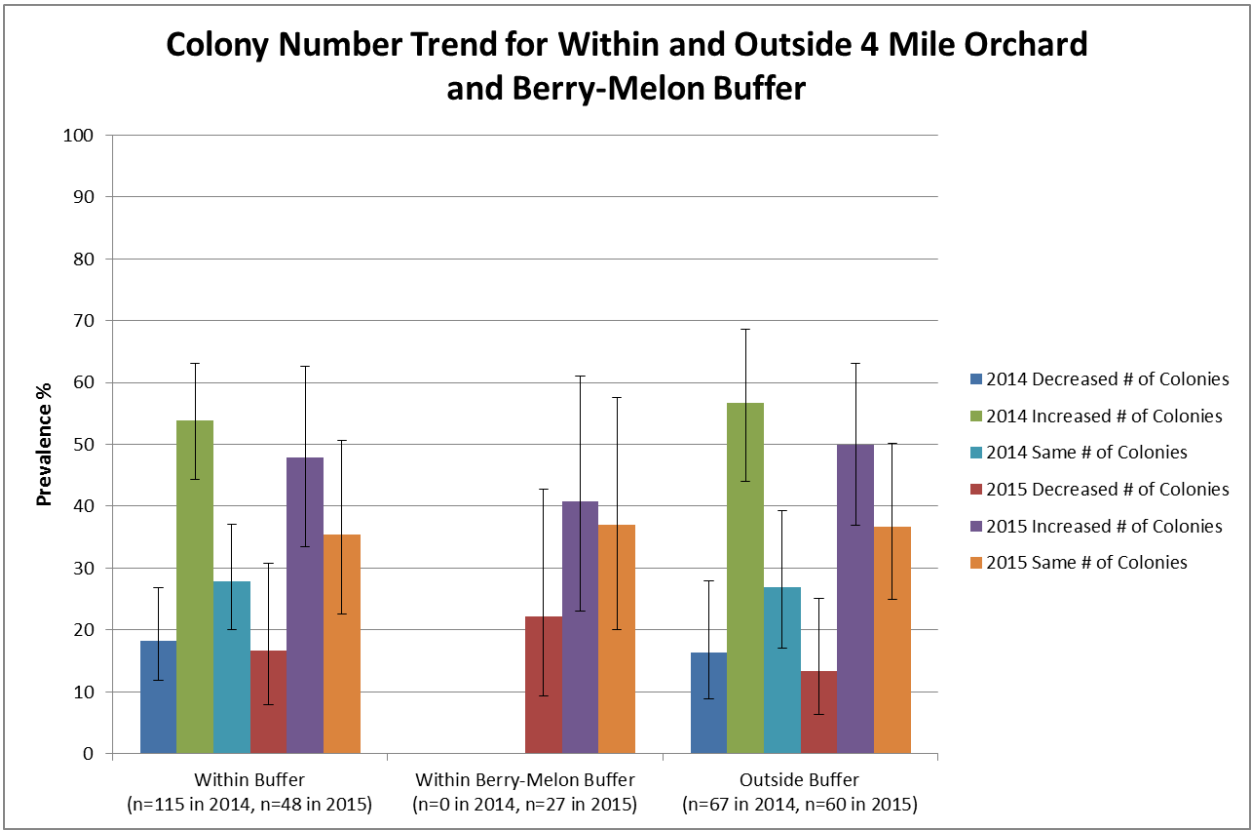

Deformed Wing Virus Prevalence Within and Outside
4 Mile Orchard and Berry-Melon Buffers
Prevelance %
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
2014
2015
Within Buffer
(n=708 in 2014, n=276 in 2015)
Within Berry-Melon Buffer
(n=0 in 2014, n=92 in 2015)
Outside Buffer
(n=282 in 2014, n=486 in 2015)

Parasitic Mite Syndrome Cases in Utah 2015



Deformed Wing Virus Cases in Utah 2015





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