

Sunflower and Honey Bee Health Summary

Data

1. Outcome variables : number of alive bees, Varroa mites and Nosema parasite loads as indicators of honey bee health.

Data source: USDA Animal and Plant Health Inspection Services (APHIS) Survey of Honey Bee Pests and Disease, containing the geographic coordinates of the apiaries.

429 apiaries in 33 states throughout the United States) and year the sample was taken (2009 to 2014). 2. sunflower acreage in a two-mile radius of apiaries from NASS Cropscape data

3. control variables : forage availability (NDVI?) and weather, from NASS' Vegscape layers and Oregon State University's Prism database.

Methods

To estimate the degree of exposure to sunflower, we map the sampled non-migratory apiaries in APHIS onto NASS cropscape data to determine the crops grown within a two-mile radius of each apiary. To control for the timing of exposure to nearby sunflowers, we collect information on the time of planting (mid-April to late May) and blooming for sunflowers (during summer and a portion of fall).

The resolution of these data is set at 30 meters squared per pixel (USDA NASS n.d.). We extract the crop area within two-miles of each apiary as this is vicinity in which bees typically do most of their foraging (Eckert, 1933). Therefore, this two-mile area, which comprises over 8,000 acres, provides the best estimate of the crops and landscape that bees would interact with during their foraging. We then calculate the percentage of the two-mile buffer area occupied by sunflower with the assumption that a linear relationship exists between changes in treated crop area and morbidity loads.

We start by exploring the correlation between sunflower and honey bee pests. We compare colonies located near sunflowers to those further away, during planting, blooming versus other times of year. We also plan to take into account the biology, honey bee educators, honey bee patterns.

Maps

1. Sunflower growing area map

Growing states: centered around South Dakota and North Dakota.

states with acres less than 100 acres: Pennsylvania, New Jersey, California, Washington, Wisconsin, Arkansas, Virginia, Texas, Michigan

2. Maps for Varroa mites and Nosema parasites for non-migratory apiaries with pollen results.

Summary Statistics

Out of a total of 743 observations over the two years (2014-2015), 72 observations in our data have sunflower within the 8000 acres area. 60 of them greater than 900 square meters .

More than half of the observations with large sunflower acreage (33 out of 60) are during July to October when there is possible sunflower blossom. 5 of them are between April to May when it is the planting season of sunflowers. Others are during November and February.

group 0 is no sunflower, group 1 is at least 900 square meters sunflower acreage within the 2 miles radius.

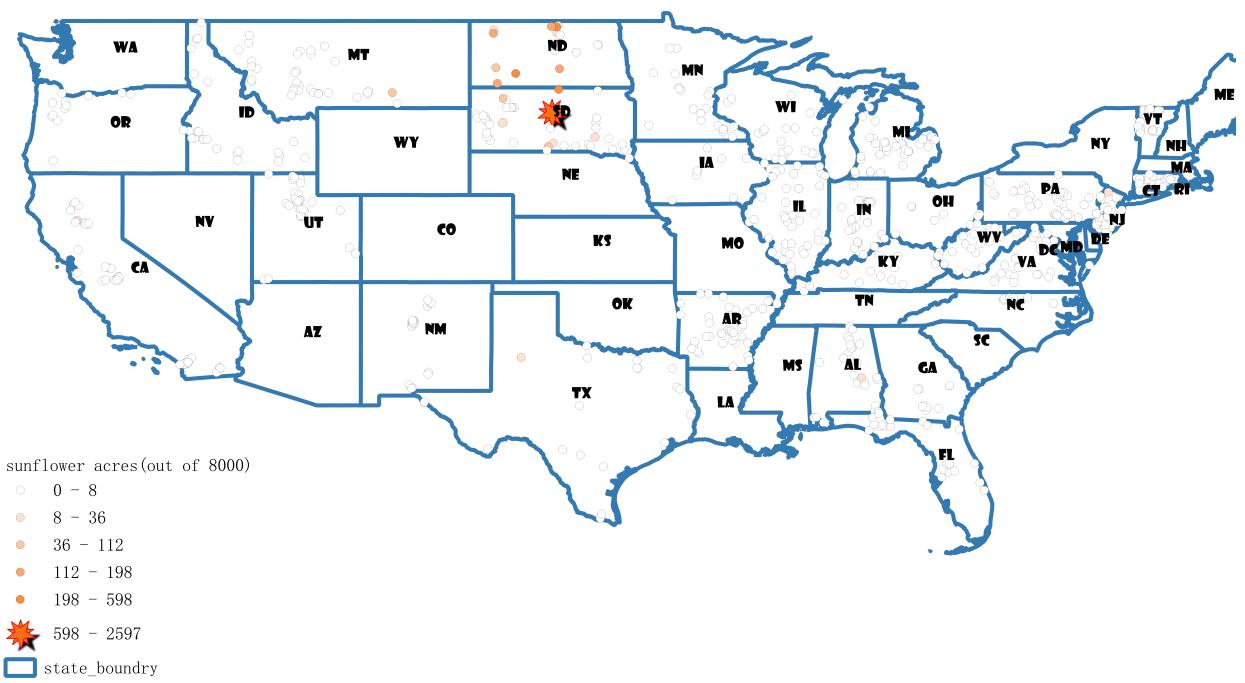


Figure 1: Map of sunflower growing area (acres in a two-mile radius)

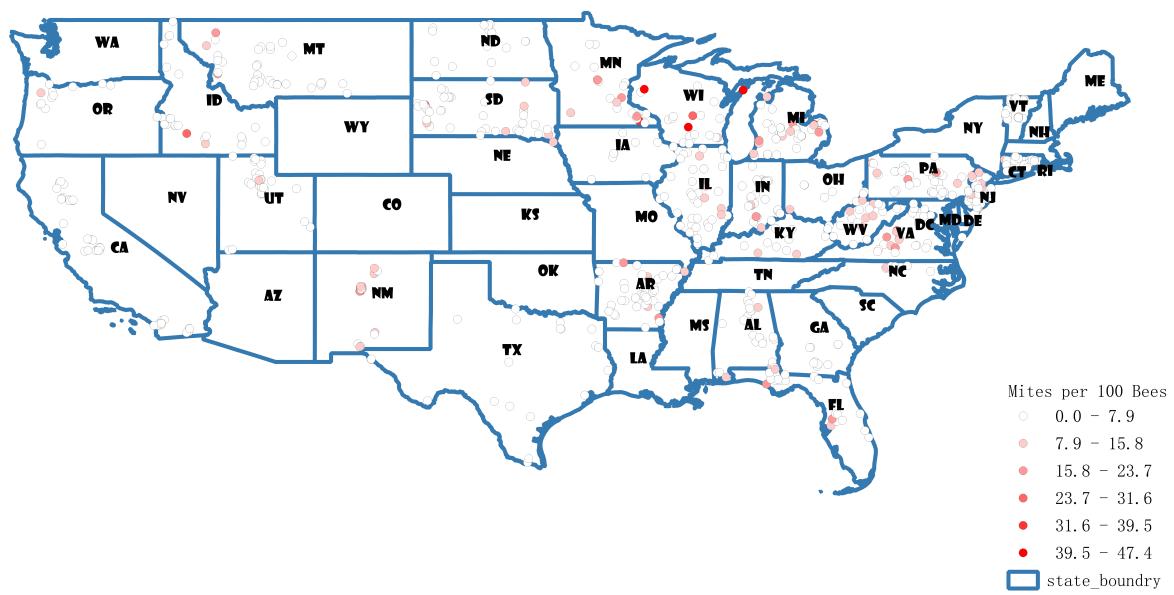


Figure 2: Map of Mites Per 100 Bees

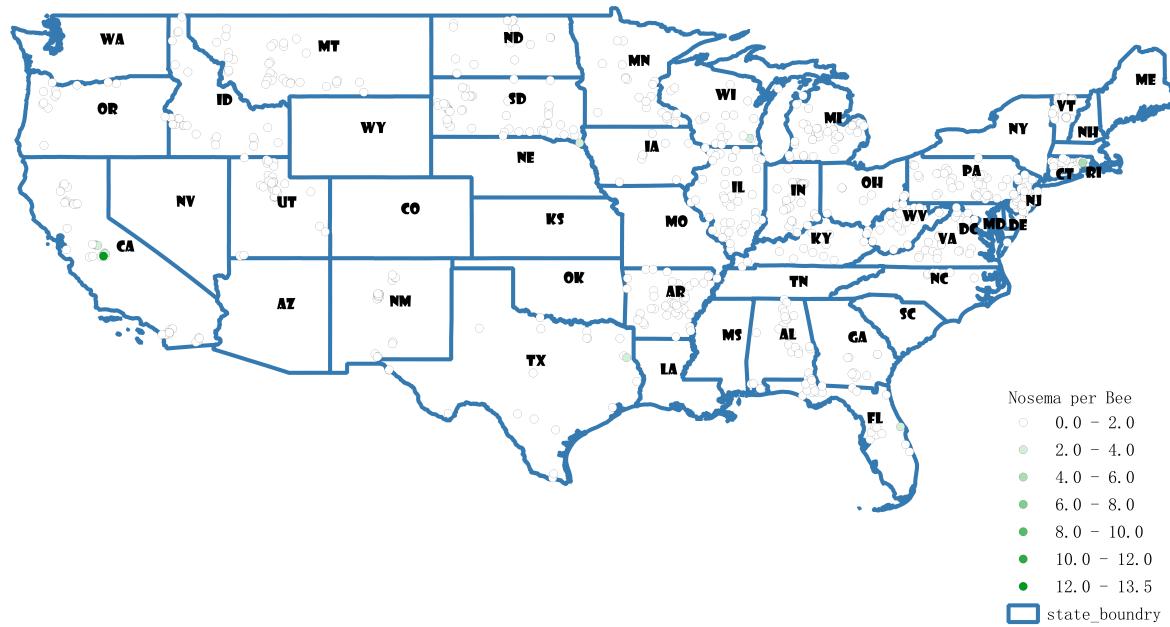


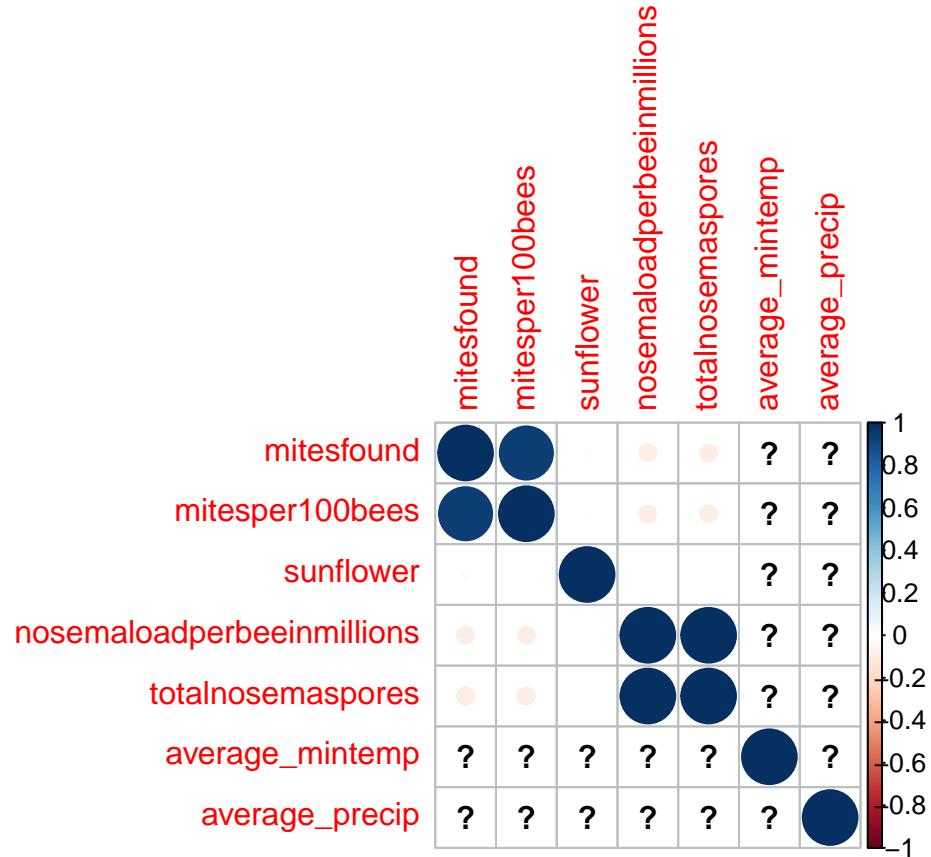
Figure 3: Map of Nosema load per Bee (in millions)

	Sunflower			No sunflower		
	Mean	Std. Dev.	Freq.	Mean	Std. Dev.	Freq.
alive	94.973	16.1975	37	92.8655	16.0662	275
mitesfound	30.0278	43.6329	72	40.4739	53.9142	671
Mitesper100bees	3.38126	4.99901	72	4.29798	5.76292	671
Nosemaloadperbeeinmillion	0.30486	0.57624	72	0.19389	0.78575	671
TotalNosemaSpores	6.09722	11.5248	72	3.87779	15.715	671
average_mintemp	10.2477	4.87128	79	12.858	5.55128	675
average_precip	81.1765	47.5754	79	85.9074	65.4473	675
neonic_crop	30.6881	24.461	84	16.0491	21.6567	688
neonicplant	0.64706	0.48072	85	0.62049	0.48562	693
neonic_crop_plant	17.1745	19.7565	8	11.0686	15.3388	103

Figure 4: summary table for sunflower vs no sunflower grown nearby

Correlation

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## corrplot 0.84 loaded
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Regression

We ran some initial regressions on all of the three outcome variables: number of bees alive, mites found and nosema load. Controlling for month fixed effect, average temperature and precipitation, we regressed the bee health variables on both the sunflower growing area and two above-cutoff dummy (900 square meters or 1 acres).

In general, the effect of sunflower on bee health is somewhat suggestive but not very strong. Using a cut off dummy, areas where more sunflowers are grown, have 27 less mites on average. Similarly, increase one square meters of sunflower in nearby area contributes to 0.41 less mites on average.

Similar result can be found for the number of bees alive but the number alive results are not statistically significant. The effects on Nosema parasite is rather negligible.