The Incidence of Lyme Disease and the Use of the Acaricide, Cyromazine, Across New York State

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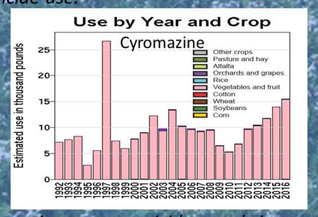
Abstract

Pesticide use aimed at arachnids, known as acaricides, are used in agricultural and lawn applications across the U.S. R Programming was used to analyze a list of acaricides. Spearman's Test found a statistically significant correlation between Cyromazine and the incidence of Lyme disease in New York state. The Kruskal-Wallis test revealed that there is a difference between the medians of the Cyromazine sample data as well as the Lyme disease data for the four years tested. Acaricide resistance genes have been documented in ticks as well as other arachnids and insects. Given the world's growing population and increasing need for arable land, the subsequent use and effect of acaricides like Cyromazine need to be researched to determine their risks.

Introduction

Although Lyme disease has been heavily researched, the bacteria continues to spread. Given the risk of Lyme disease to human health, the less than optimal treatments, and the escalating virulence, this health concern is growing into a crisis. Pesticide use aimed at arachnids, known as acaricides, have been used in agricultural and lawn applications across the U.S. The question of whether acaricide resistance is correlated with Lyme disease is addressed here. Pesticide resistance has been documented in cattle ticks with the development of a new gene in response to frequent applications in agricultural conditions. The spatial aspects of acaricide resistance could provide another dimension to Lyme disease research and acaricide use.



Cyromazine, an acaricide used in poultry cages and fruit/vegetable crops, is used across New York. It is a growth regulator which affects the nervous system of insects and arachnids.

Methodology

R Programming was used to analyze an existing stratified random sample of acaricides (kg) and Lyme disease data. Cyromazine was found to be correlated with the incidence of Lyme disease across New York. A nonparametric analysis was performed using Spearman's correlation test and Kruskal-Wallis Rank and Sum test.

The following hypotheses were tested:

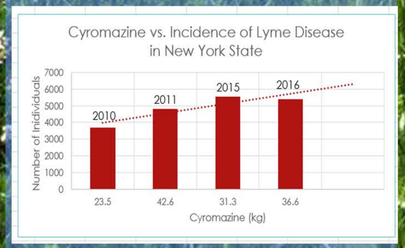
H_0: There is no correlation between the use of Cyromazine and the incidence of Lyme disease in NY Counties.

H_A: There is a correlation between the use of Cyromazine and the incidence of Lyme disease in New York Counties.

Spearman's Correlation (r_s) Cyromazine (high)

Year	*p-value*	r_s
2010	4.65×10^{-3}	-0.35
2011	6.61×10^{-3}	0.36
2015	4.32×10^{-5}	0.50
2016	2.60×10^{-2}	0.28

With low p-values, we reject the null hypothesis, there is a statistically significant relationship between Cyromazine and the incidence of Lyme disease.



Kruskal-Wallis Rank and Sum Test

H_0: The medians of four years of Cyromazine sample data are the same.

H_1: The medians of four years of Cyromazine sample data are not the same.

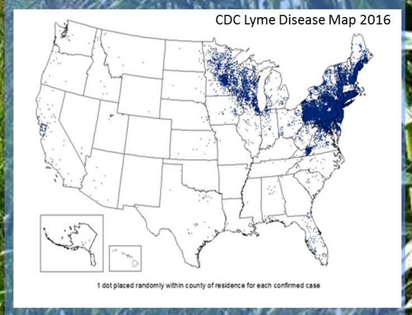
Result: Using R Programming, a low p-value of 1.18×10^{-11} confirmed that the medians over four years of Cyromazine sample data are not the same.

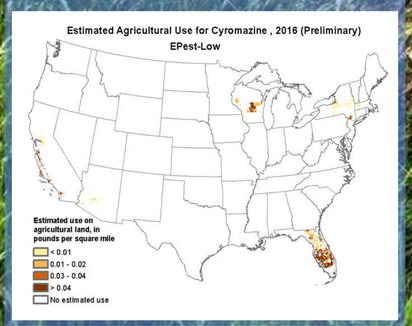
H_0: The medians of four years of Lyme disease sample data are the same.

H_2: The medians of four years of Lyme disease sample data are not the same.

Result: Using R Programming, a low p-value $< 2.2 \times 10^{-16}$ was obtained confirming that the medians over four years of Cyromazine sample data are not the same. This shows that as Cyromazine use escalated, so did the incidence of Lyme disease.

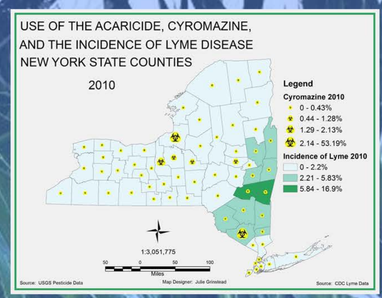
Spread of Lyme disease mirrors use of Cyromazine in 2016 (compare maps below).

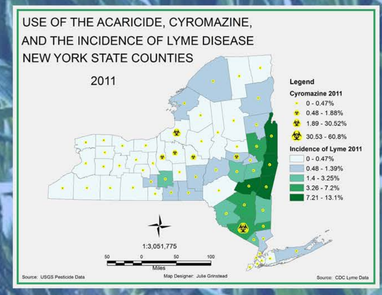


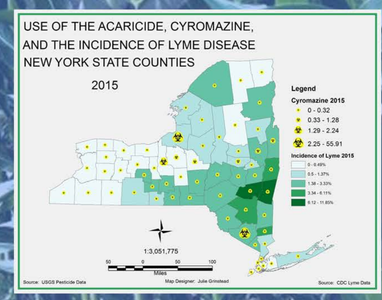


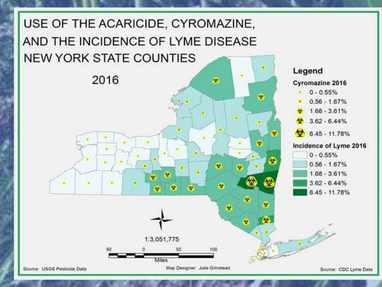
Results

The maps below reflect the progression of over time in which there is a statistically significant relationship between Cyromazine use and the incidence of Lyme disease.









Conclusion

The continued spread of Lyme disease continues to be a challenge. Many ecological aspects of the bacteria have been studied but its relationship to acaricide use is only starting to be understood. There are a myriad of acaricides on the market and many have been approved for agricultural use, however, Cyromazine shows a statistically significant relationship with the incidence of Lyme disease across New York Counties. A coincidence? Acaricide resistance genes have been documented in ticks as well as other arachnids and insects. This resistance gene can be transmitted to offspring who never come in contact with a crop field, a house lawn, or an acaricide. Given the world's growing population and increasing need for arable land, the subsequent use and effect of acaricides like Cyromazine needs to be researched and weighed in light of its risks and benefits.

References

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