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Latex Variation in Hemp Dogbane (Apocynum Cannabinum)

Michael Aikin
DePauw University

Rose Keith PhD
DePauw University

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By Michael Aikin with Dr. Rose Keith
Biology Department, DePauw University, Summer 2021

Background

Hemp Dogbane (*Apocynum cannabinum*) is a weedy perennial native to North America that can reproduce by seed or clonally. Shoots can emerge from vertically oriented crown roots or horizontally orientated lateral roots (Shultz 1979). Hemp Dogbane produces latex and cardenolides as a way of deterring potential herbivores. Latex fluid is contained in specialized cells known as laticifers. Laticifers can be a single cell or a series of cells and when physical damage is detected these cells release latex into the appropriate areas (Ramos 2019). In Apocynaceae, latex contains cardiac glycosides that take the form of cardenolides (Agrawal 2009). Herbivores like the Dogbane Beetle (Chrysochus auratus) and Dogbane Tiger moth (Cycina tenera) are specialized to consume dogbane along with its cardenolides. The dogbane beetle feeds exclusively on plants from the Apocynaceae family, and dogbane beetles prefer dogbane plants over other plants from the Apocynaceae family, like milkweed and periwinkle (MacEachern-Balodis, et al. 2017).

Photos of Hemp Dogbane from the Rim population Provided by: Brittany Way

Methods: Site description, Data Collection, and Data Analysis

3 sites were located in the quarry bottom and 3 were located outside of the quarry bottom, each with varying soil quality and water availability. Between the months of June and July flooding was common at every site and water levels varied.

Data was collected in biweekly intervals. Latex was measured by taking the dry mass of latex produced by the top leaf with the least damage from herbivores. Data analysis was conducted in R studio. For statistical tests we used one-way anovas, linear mixed models, and t-tests. The data for Figure 1 was transformed to account for skewed data caused by our means of determining fitness.

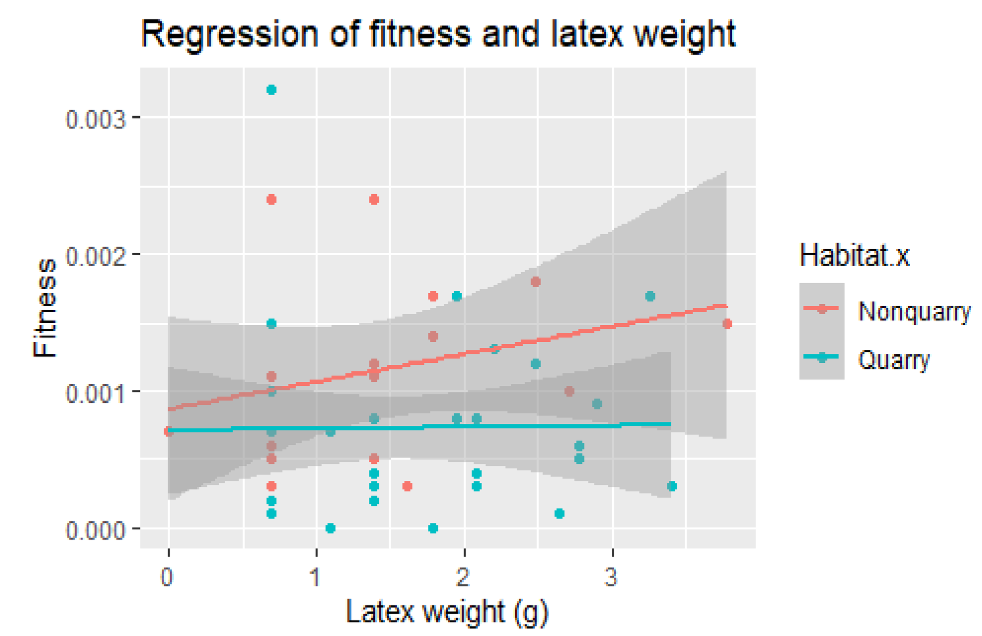

Figure 1: This figure shows the relationship between the amount of latex produced and fitness of the two habitats. There was no significant difference between the two ($p > 0.05$).

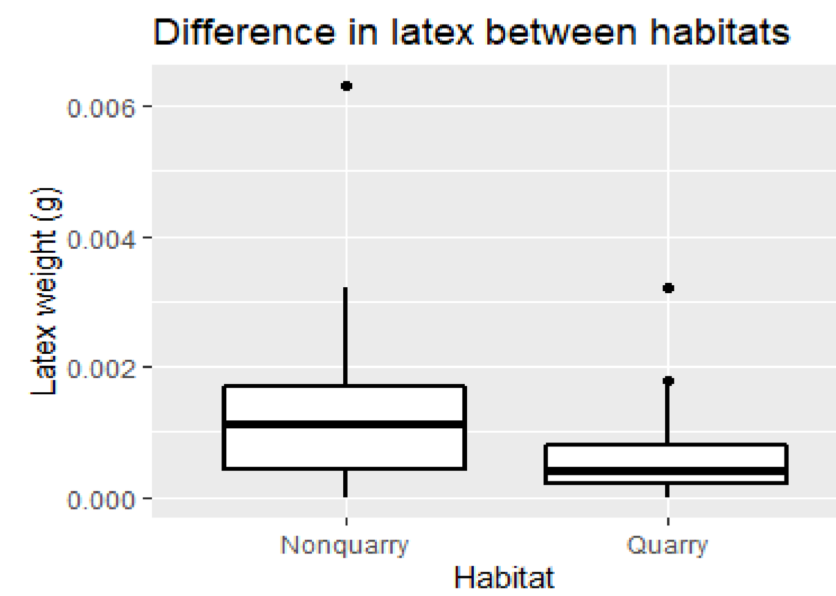

Figure 2: This figure represents the difference in latex produced between nonquarry and quarry populations. There is a significant difference between the two habitat conditions. ($p < 0.05$)

Figure 3a: This figure is looking at the latex production of nonquarry populations to determine the cause of latex weight. These three are ordered by water availability, with QM being the highest, and R1 being the lowest.

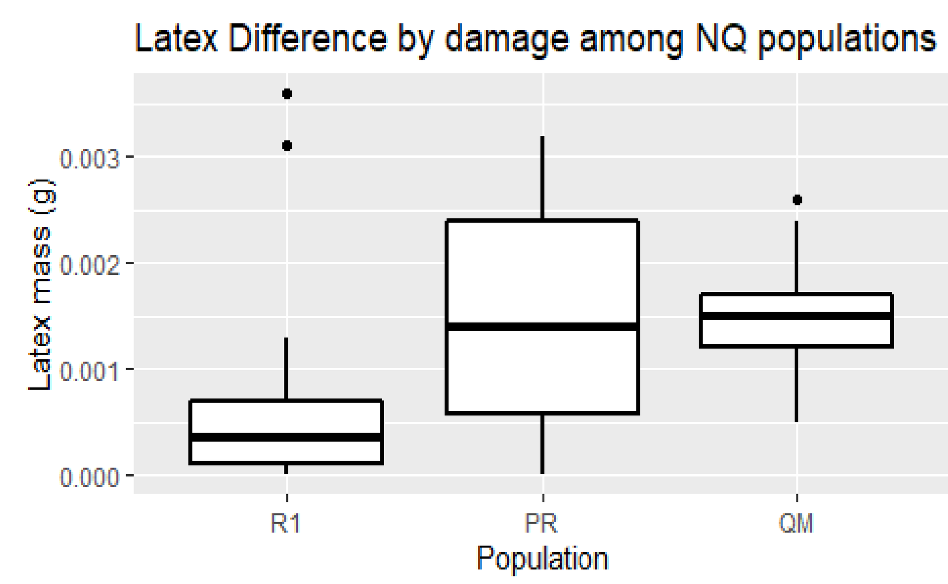

Figure 3b: This figure is looking at latex production of nonquarry populations to determine the cause of latex weight. These three are ordered by total damage from herbivores, with R1 being the highest and QM being the lowest.

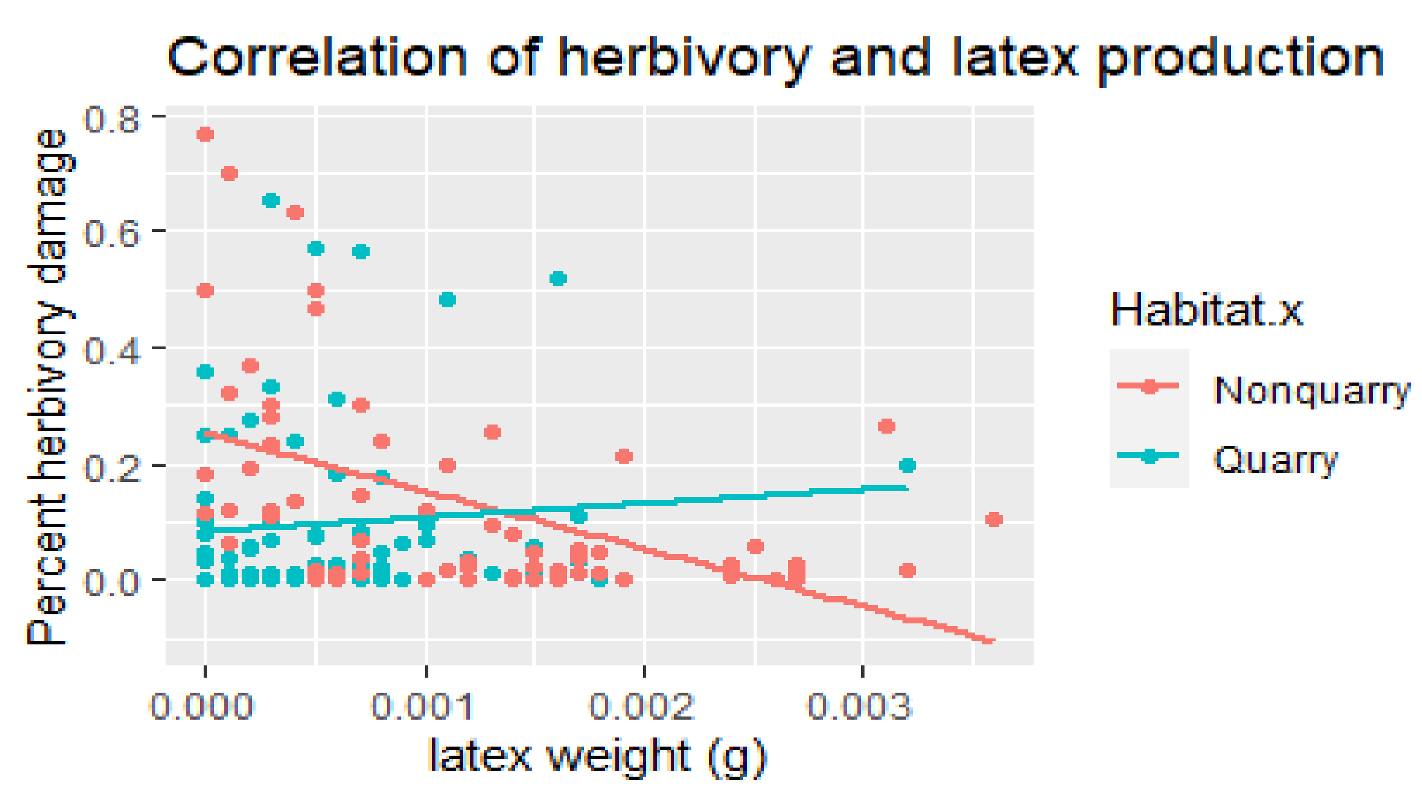

Figure 4: This figure shows the correlation between herbivory and latex production among the two habitats. The Nonquarry environment has a negative correlation between herbivory and latex weight. The inverse if true of the Quarry population.

Results and Discussion

In our analysis of the latex data, we found that there was no significant difference in fitness based on latex weight between the two habitats (Figure 1). This shows that while latex can be used as a deterrent to herbivores, its overall affect on the fitness of the plant is not significantly important. While there was no difference in fitness based on latex produced, there was still a difference in the amount of latex produced between the habitats. Figure 2 shows that the amount of latex produced was higher in nonquarry populations as compared to quarry populations. Agrawal, A. et al. (2014) found a relationship between latex production in common milkweed (*Asclepias syriaca*), a relative of Hemp Dogbane, and water availability. In their study they found that higher water availability led to higher latex production. In order to determine if this was the case, we looked herbivory in the Nonquarry population. Figure 3a and 3b help show the cause of the difference in Latex weight within the Nonquarry habitat. 3a is ordered from most water available to least water available, with QM having the most and R1 having the least. Figure 3b shows the same three populations ordered by highest average percent of herbivory, with R1 having the highest average percent and QM having the lowest average percent. With figure 3a and 3b we can see that latex production is more likely determined by the water available than the amount of herbivory affecting the plant. This makes sense considering the composition of latex. Most of the latex that leaves the plant, leaves in the form of a fluid that is dependent on water (Agrawal 2009). Our last test was used to determine If there was a significant correlation between latex production and herbivory damage. Figure 4 shows a negative correlation between herbivore damage and the amount of latex produced in the nonquarry population. This shows that latex production has an impact on the amount of herbivory the plant experiences. After using an ANOVA to test the significance of this relationship we found a p-values of less than 0.05.

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