The effect of trichome density and herbivore density on the proportion of herbivores consumed by the natural enemy *Podiusus maculiventris*

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Introduction

Trichomes—hair-like structures on leaves—can affect plant defenses against herbivores because they can act as mechanical barriers, impeding herbivore movement. However, these defenses can also negatively impact the prey-search efficiency of predators by limiting their movement on the plant.

Since predator-prey interactions are often density-dependent, understanding how trichome density influences this relationship is crucial for evaluating plant resistance.

While previous research has examined the separate effects of trichomes on herbivores and predators, few studies have explored how both trichome density and herbivore abundance influence predators' consumption rate. This study investigated **if predator consumption differs on plants with a higher or lower trichome density or at different herbivore densities**. I expected that predator consumption would be the greatest when herbivore density was high on plants with low trichome density, as the reduced physical barrier may make it easier for predators to forage effectively.

Methods

The plant used to carry out this study was *Solanum carolinense* (horse nettle). *Leptinotarsa juncta* (horse nettle beetle) is a specialist herbivore that feeds only on *S. carolinense*. *Podisus maculiventris* (spined soldier bug) is a generalist predator and can feed on *L. juncta*. These species are found in fields in the southeastern U.S. region.

Plants of two different genotypes were utilized throughout the experiment with high and low trichome densities. When each plant was placed in its respective treatment, their height was measured to ensure similar environments in relation to herbivore density and limited foraging space for the predator.

At the start of the experiment, 2nd instar larvae were placed in their treatments (Figure 1). Each treatment contained one adult predator. The herbivores were positioned higher on the plants than the predator to increase the predators' searching. Each treatment spanned a total of 72 hours. Observations were conducted once daily to count how many herbivores were consumed and how many were still present.

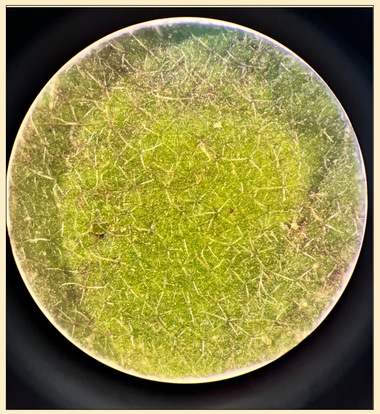

Image 1: Low density trichomes used in this study, under a microscope.

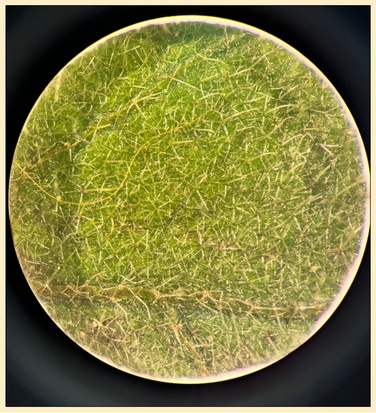

Image 2: High density trichomes used in this study under a microscope. (~80 more than low density).

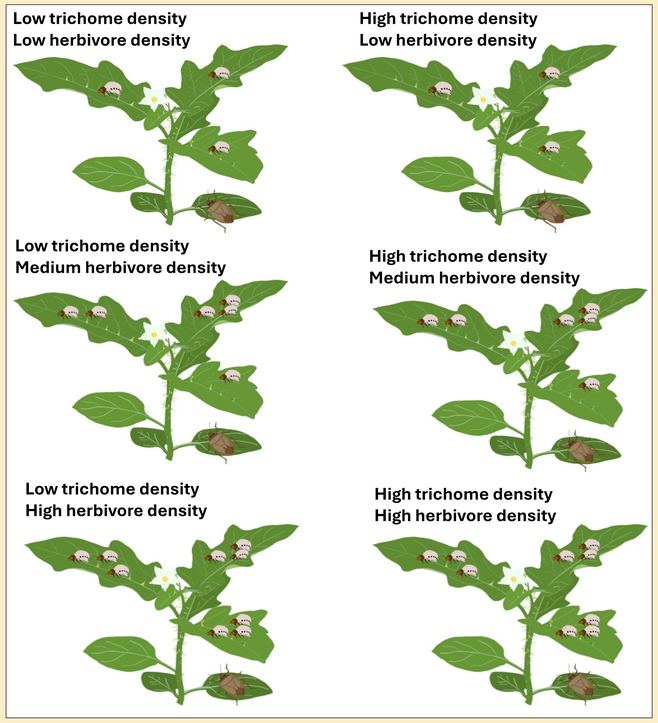

Figure 1: Experimental set-up of herbivore and trichome. Three treatments of herbivore density (3, 6, or 9) larvae) were crossed with two treatments of trichome densities (low or high density) in a green house experiment. Each treatment was replicated six times.

Results

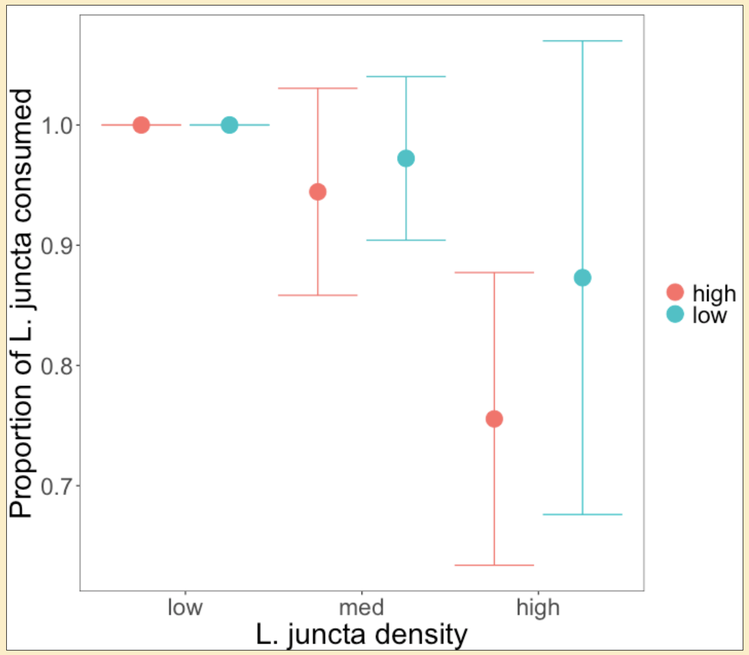

Figure 2: The effect of trichome and herbivore density on the proportion of herbivores consumed by the final observation at 72 hours. Herbivore densities are represented by low (3 larvae), medium (6 larvae), and high (9 larvae) for a total of 216 larvae observed. The orange color represents the high trichome density within each herbivore density, while the blue color represents low trichome density. Each dot represents by the average amount of herbivores consumed in each treatment by the final observation. Error bars represent standard deviation.

Trichome density did not affect predation ($F = 1.673$, $df = 1, 30$, $p = 0.206$). More herbivores were consumed at lower trichome densities, but the difference was not significant. Herbivore consumption decreased as herbivore density increased ($F = 69.348$, $df = 2, 30$, $p = 5.63e\text{-}12$), with no interaction between trichome and herbivore densities ($F = 1.105$, $df = 2, 30$, $p = 0.344$). Plant height had no effect on proportion of herbivores consumed ($t = -0.208$, $df = 34$, $p = 0.8367$).

Discussion

This study examined how trichome density in *Solanum carolinense* and herbivore density of *Leptinotarsa juncta* affected the proportion of herbivores consumed by the predator *Podisus maculiventris*.

As expected, high trichome density trended toward reducing predation, though the effect was not statistically significant. Additionally, as herbivore density increased, the proportion of herbivores consumed decreased. This followed a type II functional response, where predators reach a consumption limit.

However, contrary to expectations, no interactive effects between trichome and herbivore density were observed, suggesting that the effect of trichome density was consistent across each herbivore density.

These findings highlighted the complexity of plant defenses in shaping predator-prey interactions. While trichomes may impede predator movement, their density may not have been high enough to significantly alter consumption rates or may not strongly influence consumption rates.

Future research could explore additional plant defense mechanisms, such as herbivore-induced volatiles, to better understand how plant resistance traits impact predator efficiency and overall herbivore suppression.

Acknowledgments

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