Chlorophyll Levels in Multiflora Roses Throughout the Seasons

NRCA Student: Amritha Anup[1]

Community Partner: Lindsay Dreiss[2]

[1]Two Rivers Magnet High School; [2]Middlebury College

ABSTRACT

Multiflora rose is an extremely versatile plant species that is invasive in Connecticut. It is able to grow quickly and outcompete native species, therefore it may have negative effects on local biodiversity and ecosystem sustainability. One hypothesis of multiflora rose's extreme fitness is its ability to keep chlorophyll amounts higher throughout the year when compared to native rose species. Having more chlorophyll would allow the plant to capture more sunlight for growth, leading to a longer growing season.

As such, the goal of this project was to examine the factors that increase fitness of multiflora rose in Connecticut by assessing changes in chlorophyll levels of new and old leaves compared to another ornamental rose species that has not yet invaded Connecticut forests. Data was collected in the fall as it is the time of year in which chlorophyll levels and leaves of temperate plants drop in preparation for inactivity in the winter.

One major finding of this study was that multiflora rose species overall had more chlorophyll throughout the transition from fall to winter than other ornamental rose species. Also the multiflora rose flushed more leaves when the canopy above dropped leaves. This led to high amounts of chlorophyll production in these plants, allowing for better survival.

INTRODUCTION

Multiflora rose (*Rosa multiflora)* is an invasive plant species that is native to eastern Asia that was introduced to the U.S. in 1886, when there was a high demand for ornamental roses. In the 1930's, the U.S. Soil Conservation Service began to use these plants for erosion control and natural hedges to barricade livestock.

Multiflora rose plants can form extremely dense bushes along forest edges and overcrowd areas easily. This species is able to produce up to one million seeds per year[1], and the seeds are able to stay viable in the soil for up to twenty years[2]. The seeds are spread mainly by birds and mammals. It prevents the growth of other native plant species and reduces the amount of resources, like nutrients or sunlight, available to surrounding plants. They are able to thrive in many different conditions, but their optimal growth can be found in heavily wet or dry sites. Today, this plant species is banned from 13 states[1], including Massachusetts and Connecticut. In Connecticut, they are most common along the northeastern edge.

The objective of this study was to examine chlorophyll levels in Multiflora rose leaves during the end of the growing season. Chlorophyll is the pigment found in many plants that give its green color, and it is directly involved with photosynthesis. Some invasive species, including multiflora rose, are known for keeping their leaves longer than native plants, which would give them more time to flower and reproduce[3]. Tracking the leaves during the fall/winter months allowed for the hypothesis that chlorophyll levels decrease more slowly in Multiflora rose than ornamental roses to be tested. Furthermore, observations made in other studies show that Multiflora rose flushes new leaves late in the autumn when other species are dropping theirs (Dreiss, personal communication). This may be helpful for Multiflora rose because this allows it to be exposed to more sunlight, therefore produce more nutrients that lead to the plant's longevity.

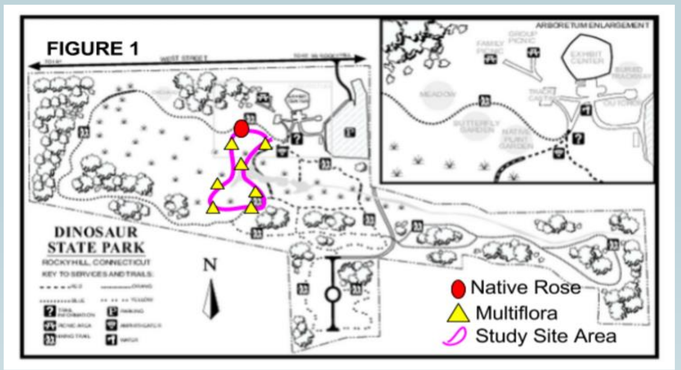

Fig 1. A map of the study area in Dinosaur State Park, located in Rocky Hill, CT. Red Circle: Native Rose site; Yellow Triangle: Multiflora rose site.

MATERIAL AND METHODS

Study Sites

- Project Location: Dinosaur State Park, Rocky Hill, CT (Fig. 1)
- Study Sites: 8 sites were located on the state park hiking trails.
- Seven sites were Multiflora rose (*Rosa multiflora*), which were located on forest edges or in the forest.
- One site was a different species of ornamental rose that has not yet invaded the forest in a garden area.
- Leaves were chosen based on size and presence of holes. Three new leaves and three old leaves were chosen to study from each study site.

Data Collection Protocol

- The 8 sites were surveyed from September 2016 to January 2017.
- At each site, the following data were collected:

Data Collected	Instrument
Temperature (°C), wind speed	Kestrel meter
Chlorophyll (new & old leaves; Fig. 2)	atLEAF meter
Leaf length (new & old leaves; Fig. 2)	Calipers
% green vegetation, % sky visible	Transparent grid

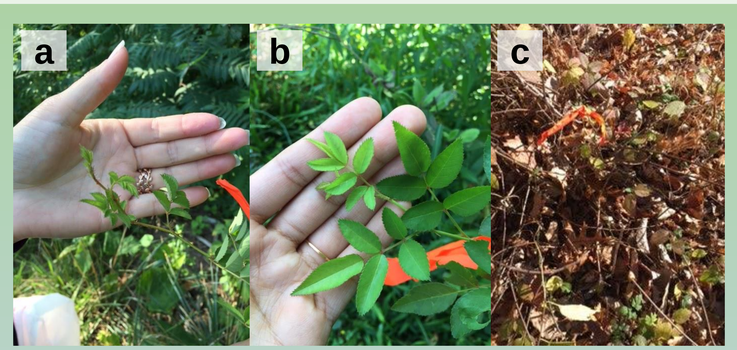

Fig 2. (a) Multiflora rose new leaves early in October. (b) Example of old (dark green leaves) and new leaves (light green leaves) of the Multiflora rose in late October. (c) One multiflora rose plant in early January, with no new leaves but a few old leaves.

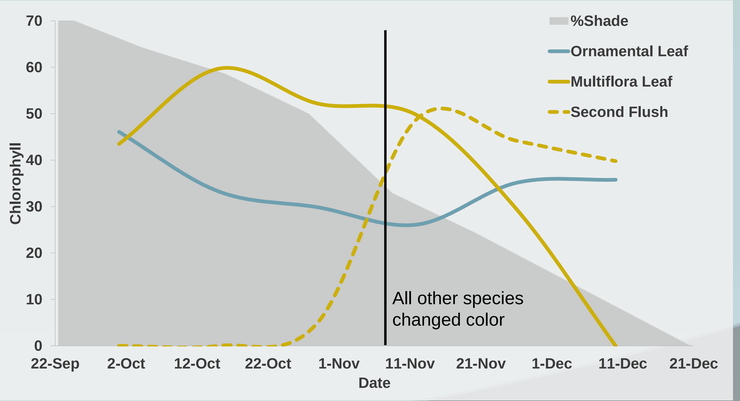

Figure 3: Example of representative multiflora (orange) and ornamental (blue) rose plants. The grey area indicates the average amount of shade present at the sites across the study period, which decreased as the canopy trees dropped their leaves.

RESULTS

The chlorophyll amounts decrease for both the ornamental rose and Multiflora rose throughout the transition from fall to winter (Fig. 4a & 4b), but the chlorophyll amounts were higher in Multiflora rose than the ornamental rose in both new and old leaves (Fig. 4a & 4b).

The decrease in chlorophyll occurred more slowly in Multiflora rose than the ornamental rose species. By mid November, most other species in the surrounding area had changed color or lost all their leaves, but Multiflora rose was still flushing new leaves (Fig. 2). Multiflora rose continued to flush more new leaves after the trees above had dropped their leaves, and this was possible because more sunlight was reaching the floor due to the trees above losing leaves (Fig. 3).

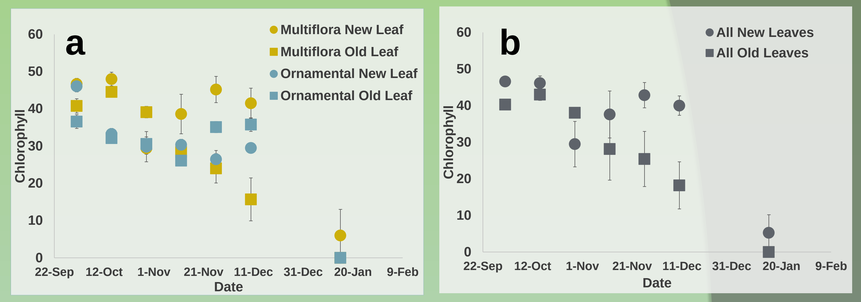

Fig 4. Average (±SE) autumn chlorophyll for newly flushed (circles) and older (squares) leaves. Measurements are grouped by (a) species (i.e., multiflora rose and ornamental rose) and (b) leaf age.

CONCLUSIONS

This data leads to several conclusions. It is normal for deciduous plants preparing for winter to have lower chlorophyll amounts. According to figure 4b, the percent sky present above each of the multiflora sites increased from October to January. Flushing more leaves enables the multiflora to take advantage of the sunlight that can reach the forest floor once the canopy trees are leafless[4]. The two plants that still had leaves on January 20 (looked similar to the pictures in Figure 2) had the most exposure to the sky[5], therefore were probably able to continue to photosynthesize and grow. Leaves will lose their "greenness" as chlorophyll breaks down and they change color in autumn. Higher chlorophyll amounts may allow Multiflora rose to be better able to achieve greater rates of photosynthesis for growth during this time compared to the ornamental rose species. Having leaves with higher amounts of chlorophyll late in the growing season or keeping leaves longer allows Multiflora rose to capture more sunlight than species that no longer have photosynthesizing leaves. This supports the hypothesis mentioned earlier, which stated that compared to the ornamental species, the Multiflora rose was able to keep higher levels of chlorophyll.

ACKNOWLEDGEMENTS

I would like to thank Laura Cisneros for introducing me to my community partner, providing me with research equipment, and keeping my project on track. I also want to thank my community partner Lindsay Dreiss for editing, revising, and guiding me through my research project.

REFERENCES

[1]"NYIS." *Multiflora Rose*. New York Invasive Species Information, Web. 04 Feb. 2017. <http://nyis.info/index.php?action=invasive_detail&id=33>

[2]Forest Invasive Plants Resource Center -*MULTIFLORA ROSE*. Forest Invasive Plants Resource Center. Forest Invasive Plants Resource Center, Web. 19 Feb. 2017. <https://www.na.fs.fed.us/spfo/invasiveplants/factsheets/pdf/multiflora-rose.pdf>

[3]Wolkovich, E.W., and Cleland, E.E. "The Phenology of Plant Invasions: A Community Ecology Perspective." The Ecological Society of America, Web. 3 Mar. 2017.

[4]Zhang, Y., Chen, J.M., and Thomas, S.C. "Retrieving Seasonal Variation in Chlorophyll Content of Overstory and Understory Sugar Maple Leaves from Leaf-level Hyperspectral Data." CASI, 2007. Web. 21 Feb. 2017.

[5]Banasiak, S.E., and Meiners, S.J. "Long Term Dynamics of Rosa Multiflora in a Successional System." Bio1 Invasions, Web. 2 Mar. 2017.