

Effect of Light Fluence on Wilting Rates in *Eupatorium rugosum*

John Compton (Dr. Stephen Saupe)

Biology Department, St. John's University and The College of St. Benedict, Collegeville MN 56321

Background

This study examined the evolutionary tradeoff plants have made to support their leaves in light-limited environments. Struik (1965) and Randall (1953) reported that herbaceous forest plants support their leaves primarily by turgor pressure, whereas plants in open areas rely more heavily on thickened cell walls and support tissues. Because forest plants rely on turgor pressure for support, they wilt more quickly and wilt after losing less water than plants in open areas. Our purpose was to test these ideas using a common Minnesota woodland plant, white snakeroot (*Eupatorium rugosum*, Asteraceae). We hypothesized that compared to plants in the light, those in light-limited environments will:

1. have less leaf support tissues;
2. wilt more rapidly; and
3. wilt after losing less water.

Methods

We measured the wilting rate of *E. rugosum* in forest interior (shade) and forest edge (sun) habitats. Time-lapse videos were made of the wilting plants using QuickCam Pro digital video cameras and the resulting videos were analyzed using ImageJ. In addition, we measured leaf area, percent leaf support tissue, and rate of leaf water loss. Sample images from a time lapse video, as well as samples of our wilting rate data obtained can be seen in Figures 1-4.

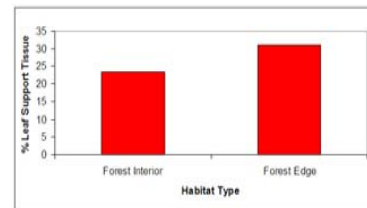


Figure 5. Percent Leaf Support Tissue in Forest Interior and Edge Habitats

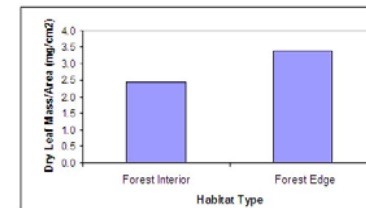


Figure 6. Dry Leaf Mass/Area in Forest Interior and Edge Habitats

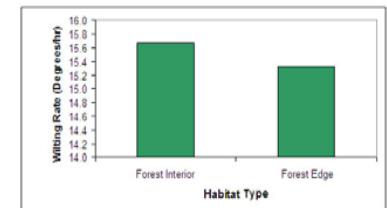


Figure 7. Wilting Rate in Forest Interior and Edge Habitats

Results

Support Tissue: We estimated leaf support tissue by calculating the ratio of dry weight to fresh weight and the ratio of dry leaf mass to leaf area. In support of our hypothesis, plants from the light-limited forest interior had a lower dry weight to fresh weight ratio than those at the sunnier forest edge (Fig. 5; $p < 0.0001$) and also had a lower dry leaf mass per leaf area (Fig 6; $p < 0.0001$).

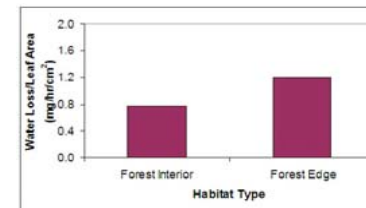


Figure 8. Water Loss/Leaf Area in Forest Interior and Forest Edge

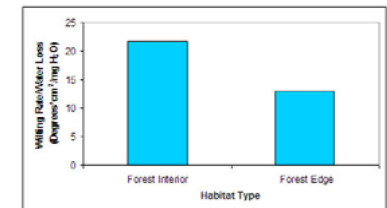


Figure 9. Wilting Rate/Water Loss in Forest Interior and Edge Habitats

Wilting Rate: Wilting rates measured from time lapse movies showed that plants from the forest interior had slightly higher wilting rates (Fig. 7; $p = 0.409$) than those from the forest edge. Although this trend supported our hypothesis, the difference was not statistically significant.

Wilting & Water Loss: Plants from the forest interior lost water at a slower rate than those at the forest edge (Fig. 8; $p < 0.0001$). When the wilting rate was expressed as a function of water loss, plants from the forest interior wilted after losing less water than those at the forest edge (Fig. 9; $p < 0.0001$).

Conclusions

Our study showed that in the higher light environment of the forest edge, *E. rugosum* invested more resources in leaf support structures. Conversely, there was less support tissue in plants from the forest interior. The plants from the forest interior wilted at a slightly higher rate and lost less water before wilting. Thus, plants in the light-limited environment were more dependent on water pressure for support than those at the forest edge. These data provide further support for the conclusions of Struik (1965) and Randall (1953), who found that other herbaceous forest species wilted after losing significantly less water than plants in the open. Data gathered on light fluence were omitted because they were incomplete and did not fully represent the fluence rates that plants experienced throughout a typical day. These results may be of practical value for plant breeders selecting for wilt-resistance.

Acknowledgements

Dr. Gordon Brown and Hannah Schwewe for their suggestions and assistance.



Figure 1. Initial Image of Plants 49-52



Figure 2. Final Image of Plants 49-52

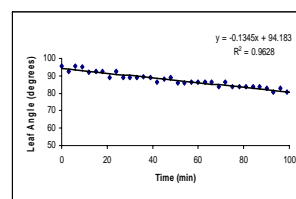


Figure 3. Plant 32 Leaf Angle vs. Time

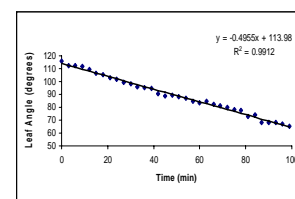


Figure 4. Plant 66 Leaf Angle vs. Time