The Affects of Root Space Restriction on Helianthus annuus

Mekayla Malarkey
Western Oregon University, mmalarkey15@mail.wou.edu

Follow this and additional works at: https://digitalcommons.wou.edu/aes
Part of the Agricultural Science Commons, and the Biology Commons

Recommended Citation
https://digitalcommons.wou.edu/aes/127

This Poster is brought to you for free and open access by the Student Scholarship at Digital Commons@WOU. It has been accepted for inclusion in Academic Excellence Showcase Proceedings by an authorized administrator of Digital Commons@WOU. For more information, please contact digitalcommons@wou.edu, kundas@mail.wou.edu, bakersc@mail.wou.edu.
The Affects of Root Space Restriction on Helianthus annuus

Kayla A. Malarkey
Western Oregon University 345 Monmouth Ave N, Monmouth OR

BACKGROUND

As space for crops becomes more limited, it is important to determine what affects this will have. One study looked at how root space restriction impacted the physiological functions of plants. It found that plants generally had less of an ability to obtain water and nutrients, thus increasing stress (Iersel, 1997). It has also been found that root restriction impacts the overall growth of a plants, especially when it comes to biomass and height (Kharkina et al., 1999). Other studies have shown similar findings. Canopy size, for example, dramatically decreased when root space is limited (Myers, 1992). However, despite the decrease, there was more reproductive growth, suggesting that the plants were using more resources to reproduce.

For this study, H. annuus was used to determine its physiological functions during root restriction. H. annuus, a huge crop, generally grows to a height of 3 meters with a large flower. It uses a medium amount of water. It needs a large amount of sunlight for optimal growing conditions. (Plant Database).

HYPOTHESIS

The restricted root space will negatively impact the plants shoot system and general physiological functions due to the container having a direct impact on the plants ability to acquire water and nutrients.

METHODS AND MATERIALS

Treatment Set Up

The control Helianthus annuus were germinated in 1 ounce plastic pots, then transferred into 4 gallon pots while the root restricted plants were germinated in 5 ounce pots, then transferred into 4 ounce pots. The plants were watered and fertilized in the first week of growth. After the first fertilization, no other fertilizer was added. The plants were watered every other day for the first 3 weeks, and then they were watered every day until the project was complete.

Dark PSI, SRA, Stomatal Density, and Midday PSI Data Collection

All plants were placed under black plastic bags to allow them to dark acclimate 12 hours before data collection. The newest, fully developed leaf was used for dark acclimated leaf water potential (PSI); Pressure Bomb, PMS instrument Co, Corvallis, OR), stomatal density (nail polish, Wet n' Wild, Industry, CA), and SRA (ImageJ, National Institutes of Health, Bethesda, MD). The plants were reacclimated to the light for 3 hours, and a second cutting was made to test midday acclimated leaf PSI measurements.

Light Curve, Maximum Photosynthesis, Transpiration, and Conductance Data Collection

The LI-6400XT (Portatile Photosynthetic System, Li-Cor, Lincoln, NE) was used to take Maximum Photosynthesis, Transpiration, Conductance and a Light Curve of all plants from 1030 to 1600. The LI-6400XT (Portable Photosynthetic System, Li-Cor, Lincoln, NE) was set to the ambient room temperature with a CO₂ concentration of 390ppm. Once stable conditions were met, the PAR (photons/m²/s) was slowly lowered by 300µmolm²s⁻¹ until the stomata were closed.

Minimum Transpiration and Conductance Data Collection

The LI-6400XT (Portable Photosynthetic System, Li-Cor, Lincoln, NE) was set to the ambient room temperature with a CO₂ concentration of 390ppm. Once stable conditions were met, the PAR (photons/m²/s) was slowly lowered by 300µmolm²s⁻¹ until the stomata were closed.

RESULTS

Stomata produced (t = 3.51, P<0.05). It did not, however, have a significant impact on the amount of adaxial stomata produced (t = -1.00, P>0.05). Root Restriction had a significantly negative impact on the amount of abaxial stomata (t = -2.970, P<0.01) Root Restriction did not significantly impact stem height or change in leaves (t = -0.32, P>0.05; t = 0.48, P>0.05; however, root restriction did have a negative impact on the Mass of Single Wk 6 Leaf (g) (t = 7.080, P<0.01). Root Restriction had a positive impact on the average leaf mass of a week 6 leaf (t = 19.00, P<0.01). Root Restriction had a positive impact on the average photosynthesis of a single leaf during week 6 (t = 13.603, P<0.001) Root Restriction had a positive impact on the photosynthesis of single leaf during week 6 (t = 19.00, P<0.01). Root Restriction had a positive impact on the photosynthesis of a single leaf during week 6 (t = 19.00, P<0.01).

ACKNOWLEDGEMENTS

I would like to thank Tori Crumrine, Riley Greenfield, and Devon Shields for their help in the set up and care of the experiment. I would also like to thank my professor for the assistance with data collection and poster set up.

REFERENCES AND ACKNOWLEDGEMENTS

Myers S. Root Restriction of Apple and Peach with In-Ground Fabric Containers. ACTA Hort. 1992; 327.

** Statistically Significant P<0.05 ** Statistically Significant P<0.01 *** Statistically Significant P<0.001

*Figure 1: The effects of root restriction on water potential during the least (dark) and most stressful (midday) times of day. Averages are shown (n=6). Black bars show ±1 SD.*

*Figure 2: The effects of root restriction on number of leaves produced (A), stem height (B), and standard leaf area (C). Averages are shown (n=6). Black bars show ±1 SD.*

*Table 1: Averages of Root Restricted and Control Plants*

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Treatment Type</th>
<th>Average</th>
<th>SD</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dark Respiration Rate (CRER)</td>
<td>Control</td>
<td>-1.695</td>
<td>0.071</td>
<td>10^-14</td>
</tr>
<tr>
<td></td>
<td>Root Restricted</td>
<td>-1.647</td>
<td>0.089</td>
<td>P&lt;0.01</td>
</tr>
<tr>
<td>Light Compensation Point (LCP)</td>
<td>Control</td>
<td>31.060</td>
<td>0.698</td>
<td>10^-14</td>
</tr>
<tr>
<td></td>
<td>Root Restricted</td>
<td>31.569</td>
<td>3.783</td>
<td>P&gt;0.05</td>
</tr>
<tr>
<td>Quantum Efficiency (QE)</td>
<td>Control</td>
<td>0.078</td>
<td>0.000</td>
<td>10^-14</td>
</tr>
<tr>
<td></td>
<td>Root Restricted</td>
<td>0.067</td>
<td>0.000</td>
<td>10^-14</td>
</tr>
<tr>
<td>Max Conductance (µmol/m²/s)</td>
<td>Control</td>
<td>4.805</td>
<td>1.153</td>
<td>10^-14</td>
</tr>
<tr>
<td></td>
<td>Root Restricted</td>
<td>4.213</td>
<td>0.768</td>
<td>P&lt;0.05</td>
</tr>
<tr>
<td>Photosynthetically Active Radiation (µmol/m²/s)</td>
<td>Control</td>
<td>3.5E-10</td>
<td>3.5E-10</td>
<td>10^-14</td>
</tr>
<tr>
<td></td>
<td>Root Restricted</td>
<td>3.5E-10</td>
<td>3.5E-10</td>
<td>10^-14</td>
</tr>
</tbody>
</table>