IRRIGATION MANAGEMENT AND THE INCIDENCE OF PHYTOPHTHORA ROOT ROT IN YOUNG WALNUT TREES

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ABSTRACT

The loss of walnut trees following spring planting has noticeably increased over the past few years. Symptoms include poor or minimal vegetative growth to outright tree death within the first season. Surviving trees with minimal first season growth often continue to perform poorly in the succeeding year and eventually are replaced. Possible explanations range from wet springs that saturate the root zone to the use/misuse of new technology irrigation systems such as micro-irrigation irrigation systems (drip and microsprinklers). Both can encourage Phytophthora root and crown rot.

Continued observation of these problems has resulted in an emergence of two factors as important to the problem: first a desire to maximize tree growth can lead to over-irrigation and second, many growers are uncertain about proper irrigation frequency, duration, and quantity of applied water. The presence/absence of Phytophthora inoculum can further complicate the situation. Over-irrigation can be prevented by reducing irrigation volumes to the estimated water use or by the correct use of soil-based water status devices to prevent soil saturation. However, no comprehensive guidelines for irrigating young walnuts currently exist.

This study seeks to determine the responses of English walnut (Chandler cultivar) grafted on Northern California Black and Paradox rootstocks to irrigation frequency, duration and quantity of applied irrigation water with and without soil infestation by Phytophthora. The responses evaluated will include magnitude of tree growth and incidence of Phytophthora-included disease.

OBJECTIVES

(1) Determine growth response of English walnut grafted to both Northern California Black and Paradox rootstocks walnut rootstocks to irrigation frequency, duration and quantity of applied water.
(2) Evaluate the response (Objective 1) with and without inoculation of Phytophthora and the possible interaction.
(3) Determine the extent of wetted soil volume and the quality (matric potential) of the wetted area which produces optimal vegetative growth.
(4) Develop a method of estimating the required applied water volume in newly planted trees to maximize growth and minimize disease hazard.

PROCEDURES

Treatments: Irrigation treatments: 4-irrigation duration and 3 irrigation frequencies are combined to provide 6 treatments, which vary the irrigation quantity (1x, 2x, and 4x). The
irrigation quantity is held constant in the 2x treatments (T2, T3 T4 and T5) while varying the duration and frequency. The 2x treatments would be determined by the weekly estimate of applied water required for T2 through T5. The other treatments (T1 and T6) are scaled based on the 2x irrigation volumes.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration (min)</td>
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<td>25</td>
<td>33</td>
<td>50</td>
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<td>100</td>
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<td>Frequency (times/wk)</td>
<td>1.01</td>
<td>4.03</td>
<td>3.05</td>
<td>2.02</td>
<td>1.01</td>
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<tr>
<td>Emitter flow rate (g/hr)</td>
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<td>4</td>
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<tr>
<td>Volume (gal/wk)</td>
<td>3.36</td>
<td>6.72</td>
<td>6.72</td>
<td>6.72</td>
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<td>13.44</td>
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*Field Site:* The planting is located at Campbell Tract on the University of California Davis campus (LAWR field site). The soil is a clay loam. The irrigation system is a single micro sprinkler per tree discharging 4.0 gallons per hour. The heads are Bowsmith full circle pattern achieving a 10-foot maximum diameter. The heads are atop a 9-inch stand placed 36 inches to the west from each tree. Water is supplied from the campus-pressurized source.

*Experimental Design:* The design would be a factorial with four replications. The irrigation treatments will be randomized within each replication. The rootstocks (with and without inoculum) will be randomized within the irrigation treatments.

- 4 trees per plot
- Trees planted: 384
- Area planted at 15 x 24 = 3.2 acres

*Field Activities:* The field site was chiseled to 3 feet and land planed in fall 1999. All buried portions of the irrigation system were installed at that time also. The grafted trees were held in cold storage due to wet soil conditions at the site. The trees were planted into moist soil May 4, 2000. The above ground portions of the irrigation system were installed shortly after planting.

Irrigation: Water was applied to maintain adequate soil moisture in the root zone throughout the season based on soil monitoring. All treatments were irrigated equally to promote uniform growth. Water applied from planting through November 5th totaled 603 gallons per tree or 2.7 acre inches per acre.

Cultural practices: Mites were controlled with a directed application of Kelthane on July 19. The trees were fertilized using UN32 on July 21st and again on August 25th. Weeds were controlled by hoeing and spot spraying summer annuals followed by an application of a pre-emergence herbicide (Prowl) on October 25, 2000.

Inoculation: Inoculation of the soil with cultures of Phytophthora species: *P. citrocola* and *P. cinnamomi* was performed September 5th 2000. The prepared cultures were placed to the on each side to the tree and rotor filled into the soil to a depth of 4 to 5 inches. Care was taken not to contaminate adjacent non-inoculated treatments.

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Field Instrumentation: Neutron probe wells were installed in a grid fashion in each of the treatments to assess soil moisture wetted area and volume.

2001 Planned Activities: Soil water quality measurement (matric potential in wetted area) will be installed in the spring 2001. Irrigation treatments will be imposed beginning in the spring with the date determined by soil moisture and rainfall. Tree growth (trunk circumference and height) will be measured. Leaf/stem water potential data will also be taken. A disease evaluation will be made at the end of the season.