Introduction

The use of grafted watermelon transplants is becoming increasingly popular as an alternative strategy to manage soilborne disease in the U.S. The inherent challenges and costs of producing grafted watermelon transplants include: additional greenhouse space that is needed to grow the rootstock and to grafted the plants; extra labor that is needed to perform the grafting; and special facilities that are required for the proper handling and aclimation of the grafted seedlings. These facilities range from relatively inexpensive modified greenhouses to state-of-the-art climate-controlled growth chambers.

Study Objectives

To provide a general guide for evaluating the feasibility of growing grafted greenhouse seedless watermelon transplants, and using grafted transplants to produce seedless watermelon in Washington State.

Methodology

• Data on grafting supplies and labor were obtained from related studies at the WSU Mount Vernon Northwest Washington Research and Extension Center.
• Greenhouse production costs were estimated from a composite of information gathered in 2014 from growers in eastern Washington and Oregon who produce non-grafted transplants.
• Data on crop yield resulting from field utilization of grafted transplants were obtained from WSU field experiments in eastern Washington.
• Enterprise budget analysis was employed to estimate the costs and returns of producing non-grafted and grafted transplants in a greenhouse.
• Data from Galinato, Miles, and Winer. 2014. 2013 Cost Estimation of Producing Seedless Watermelon in Eastern Washington. WSU Ext. Pub. FS555E were used and adjusted to reflect 2014 prices.
• A partial budget framework was used to calculate the net change in profit that can be expected from the field utilization of grafted transplants.

Greenhouse Production of Watermelon Transplants

Assumptions

Both non-grafted and grafted transplants
• 20 x 100 ft greenhouse with polycarbonate end walls
• 1,400 trays per greenhouse; 128 cells per tray
• 80% of cells have viable plants - 143,380 plants/house
• Growing season = 35 days before planting in field
Grafted transplants
• Grafting is an add-on operation to the existing greenhouse enterprise.
• An additional greenhouse is built to grow scion.
• Grafting costs include labor, supplies and heating chamber.
• Grafted plants are placed on racks with a misting system.

Economic Feasibility Results

• Baseline: Total production cost of non-grafted transplants is about $5,748/yr (Table 1). Producer receives a net return of about $8,587/yr. The break-even price is about $0.04/plant given 143,360 plants grown in a greenhouse.
• Holding all else constant, production of grafted plants show:
• Total production costs increase to about $27,961/yr with the additional grafting costs.
• The selling price must be approximately $0.25/plant to achieve the same net returns as for non-grafted plants.
• The break-even price required for 143,360 grafted plants is about $0.20/plant.

Table 1. Estimated costs and returns ($/year) of producing non-grafted and grafted seedless watermelon transplants in a greenhouse in Washington in 2014.

<table>
<thead>
<tr>
<th></th>
<th>Non-grafted</th>
<th>Grafted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield (no. of plants)</td>
<td>143,360</td>
<td>143,360</td>
</tr>
<tr>
<td>Price (E/plant)</td>
<td>$0.10</td>
<td>$0.25</td>
</tr>
<tr>
<td>Total Return</td>
<td>$14,336</td>
<td>$36,547</td>
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</tbody>
</table>

Field Utilization of Watermelon Transplants

Assumptions

Using non-grafted transplants (baseline)
• Yield = 25 tons/acre sold at a price of $374.40/ton.
• Grafting the seeds to the nursery.
• Cost of transplants = $6.10/plant (excluding the seed cost); cost is a mark-up of 2.5 times the break-even price of grafted transplants.
• Total cost of seedless watermelon production in eastern Washington as of 2014 = $7,887/acre (Galinato, Miles & Winer 2014).
• Estimated net return = $1,473/acre.

Using grafted transplants
• Grower provides both rootstock and scion seeds to nursery.
• Cost of transplants = $6.50/plant (assuming a mark-up of 2.5 times the break-even price of grafted transplants).
• Reduction in costs due to elimination of fumigation, disease control and non-grafted transplants.
• Increase in crop yield by 35% relative to 25 tons/acre of non-grafted watermelon; hence additional revenue is obtained.

Economic Feasibility Results

• Partial budget analysis (Table 2) shows that, holding all else constant, using grafted transplants in the field production of seedless watermelon leads to a net change in profit of about $1,375/acre.
• The above positive net change means that profit increases from $1,473/acre to $2,830/acre.

Sensitivity Analysis

Different crop yields
• Expected profit increases as the crop yield increases, when other factors remain constant (Figure 3).
• Grower breaks even when yield is about 24.5 tons/acre.
• If a grower’s goal is to earn a minimum of $1,000/acre, the yield of grafted seedless watermelons must be about 27.4 tons/acre.
• Profit will be equal to that of the non-grafted crop ($1,473/acre) if the yield of grafted seedless watermelon is about 28.8 tons/acre (15.2% yield increase relative to baseline).

Sensitivity Analysis (continued)

Different prices of grafted watermelon transplants
• Expected profit declines as price of grafted transplants increases, when other variables remain constant (Figure 2).
• Grower breaks even when transplant cost about $1.38/plant.
• To obtain a net return of $1,473/acre, a grower would be willing to pay no more than $0.92/plant.

Table 2. Partial budget ($/acre) for field utilization of grafted seedless watermelon transplants.

<table>
<thead>
<tr>
<th></th>
<th>Non-grafted</th>
<th>Grafted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Return</td>
<td>$4,074</td>
<td>$1,000</td>
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<tr>
<td>Additional Costs</td>
<td>$2,000</td>
<td>$1,000</td>
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<tr>
<td>Total Return</td>
<td>$6,074</td>
<td>$2,000</td>
</tr>
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</table>

Summary

• Results suggest that the production of grafted watermelon transplants can be economically feasible for commercial greenhouse propagators if the transplants can be sold at more than $0.20/plant.
• The extra cost of grafted transplants can be acceptable to watermelon producers if using these transplants would provide a viable alternative to field fumigation and they improve crop yield.
• From the watermelon producer’s perspective, use of grafted over non-grafted transplants will be primarily based on the benefits gained from the effectiveness of grafted transplants as an alternative to chemical use in managing soilborne disease (or other pests). Benefits include reduced overall costs, improved yield, and maintained or augmented profit relative to using non-grafted transplants.

Additional Information

• This study is published as a WSU Extension Publication.
• More information about WSU research on grafting vegetables can be found at: http://vegetables.wsu.edu/grafingVegetables.html
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• This research was supported by USDA-NIFA Hatch Project 1006860.