Impact of Winter Wheat Management on Processing Tomato Yield and Quality.

2008 Research Report

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Prepared for the Ontario Tomato Research Institute

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The small plot yields presented in this report are for comparative purposes only and may not accurately reflect commercial yields. We welcome any questions, comments, concerns on this report, particularly suggestions on how to improve or make the trials more meaningful.
Executive Summary 2008:
In Leamington and Ridgetown, three winter wheat management practices 1) no treatment – leaving the straw in the field, 2) removing straw after wheat harvest, or 3) leaving the straw in the field and adding a fall application of nitrogen fertilizer at 30 lb N/ac – were established in 2007 to evaluate the impact on the following year’s processing tomato crop. At Leamington, the rye cover crop/windbreak likely masked any effect of straw management as there were no differences in yield between wheat treatments. At Ridgetown, both red and total tomato yields were significantly lower with removing straw compared to adding fall N to the straw. Leaving the straw in the field resulted in intermediate yields. Although there were slight differences observed with wheat management practices on processing tomato quality (colour, soluble solids, and pH) in 2008 at Ridgetown, these effects appear to be of little practical significance. At Ridgetown, for two contrasting weather years (2007 and 2008, the results indicate that removing wheat straw is not recommended because 1) there may be an added expense to this practice and 2) there is a yield penalty compared to leaving wheat straw in the field.

Introduction:
There is some concern by processing tomato growers that too much winter wheat stubble may have negative effects on the next year’s tomato crop. Therefore, some growers bale the wheat straw to remove it from the field. Other growers leave the straw in the field but apply fall nitrogen fertilizer to encourage soil organisms to break down the straw. There is little knowledge about the impact of these winter wheat management practices on processing tomato yield and quality. Therefore, an experiment was designed to evaluate if straw removal or leaving the straw in the field and adding fall N is beneficial compared to leaving the wheat straw in the field (no treatment).

Objectives:
- To evaluate the impact of wheat management on tomato yield and quality.
- Assess nitrogen dynamics in a wheat-tomato rotation.

Methods:
ROTATION: 2007 harvest winter wheat – 2008 processing tomatoes
LOCATIONS: Ridgetown Campus research plots and Leamington commercial field
DESIGN: Randomized complete block design
Replications: 4
Plot width: 20 ft
Plot length: 26 ft
PEST CONTROL was according to typical Ontario production practices.

TREATMENTS:

Fall 2007 Trial established after winter wheat harvest
Wheat treatments 1) no treatment – left wheat straw in the field
   2) wheat straw removed
   3) wheat straw left and added 30 lb N/ac of ammonium nitrate

Spring 2008 Planted processing tomatoes
Tomato treatments 1) no nitrogen fertilizer applied
   2) Ridgetown: 130 lb N/ac
      Leamington: 100 + 100 lb N/ac preplant and sidedressed

The zero N treatment was included to exaggerate the potential impact of N tie-up by the wheat straw and to follow soil N dynamics.

Soil temperature and moisture was measured before and after tomato planting.

Table 1. Site characteristics.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Ridgetown Campus</th>
<th>Leamington</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variety</td>
<td>CC337</td>
<td>611</td>
</tr>
<tr>
<td>Plant population (plants/ac)</td>
<td>12000</td>
<td>11600</td>
</tr>
<tr>
<td>Plant spacing</td>
<td>18”</td>
<td>17”</td>
</tr>
<tr>
<td>Row spacing</td>
<td>5’ beds</td>
<td>5’ beds</td>
</tr>
<tr>
<td>Fall tillage</td>
<td>Nov. 1 2007</td>
<td>Sept 20, 2007</td>
</tr>
<tr>
<td>Planting date</td>
<td>May 26, 2008</td>
<td>May 13, 2008</td>
</tr>
<tr>
<td>Harvest date</td>
<td>Sept. 4, 2008</td>
<td>Aug. 28, 2008</td>
</tr>
<tr>
<td>Monthly rainfall:</td>
<td>May 3.0”</td>
<td>1.6”</td>
</tr>
<tr>
<td></td>
<td>June 4.9”</td>
<td>3.5”</td>
</tr>
<tr>
<td></td>
<td>July 1.0”</td>
<td>2.8”</td>
</tr>
<tr>
<td></td>
<td>August 1.5”</td>
<td>0.3”</td>
</tr>
<tr>
<td></td>
<td>Sept 1-12th 0 (from 1st-12th)</td>
<td>4.4”</td>
</tr>
<tr>
<td>Soil characteristics:</td>
<td>pH 5.0</td>
<td>6.3</td>
</tr>
<tr>
<td>Soil texture</td>
<td>Sandy Loam</td>
<td>Sandy Loam</td>
</tr>
<tr>
<td>% sand:silt:clay</td>
<td>61:21:18</td>
<td>77:10:13</td>
</tr>
<tr>
<td>% OM</td>
<td>1.9</td>
<td>3.5</td>
</tr>
<tr>
<td>CEC (MEQ/100g)</td>
<td>10.0</td>
<td>72.6</td>
</tr>
<tr>
<td>P (ppm)</td>
<td>63</td>
<td>42</td>
</tr>
<tr>
<td>K (ppm)</td>
<td>152</td>
<td>265</td>
</tr>
<tr>
<td>Ca (ppm)</td>
<td>674</td>
<td>1199</td>
</tr>
<tr>
<td>Mg (ppm)</td>
<td>64</td>
<td>124</td>
</tr>
</tbody>
</table>
Observations 2008:
At Leamington
- There was no difference in visual rates between all three wheat treatments in the amount of wheat residue on the soil surface the following spring (Photo 1). The cereal cover crop residue was very evident.

Photo 1. At Leamington site, wheat residue on 6 June 2008 in a) no treatment – straw left in field, b) straw + fall N, and c) straw removed.
At Ridgetown
- There was more wheat residue on the soil surface in the leaving the straw in the field (no treatment control) and the fall N+straw compared to when straw was removed (Photo 1). There were no visual differences in wheat residue between leaving the straw in the field and the fall N+straw.

Photo 2. At Ridgetown site, wheat residue on 6 June 2008 in a) no treatment – straw left in field, b) straw + fall N, and c) straw removed.
Results 2008:
YIELDS (Table 2):

Table 2. Impact of winter wheat management and N fertilizer on processing tomato yields.

<table>
<thead>
<tr>
<th>Wheat residue treatment</th>
<th>Ridgetown</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Red</td>
<td>Green</td>
<td>Total</td>
<td>Red</td>
<td>Green</td>
<td>Total</td>
<td>Yield (t/ac)</td>
<td></td>
</tr>
<tr>
<td>No treatment – straw left in field</td>
<td>27.3</td>
<td>ab</td>
<td>1.1 a</td>
<td>28.4 ab</td>
<td>53.2 a</td>
<td>1.0 a</td>
<td>54.2 a</td>
<td></td>
</tr>
<tr>
<td>Straw removed</td>
<td>22.7 a</td>
<td>1.7 a</td>
<td>24.3 a</td>
<td>50.0 a</td>
<td>1.0 a</td>
<td>51.0 a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Straw left + fall N</td>
<td>30.3 b</td>
<td>1.7 a</td>
<td>32.0 b</td>
<td>49.4 a</td>
<td>1.4 a</td>
<td>50.8 a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zero N on tomatoes</td>
<td>24.7 z</td>
<td>1.0 z</td>
<td>25.7 z</td>
<td>44.2 z</td>
<td>0.9 z</td>
<td>45.2 z</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N on tomatoes</td>
<td>28.8 y</td>
<td>2.0 y</td>
<td>30.8 y</td>
<td>57.5 y</td>
<td>1.3 z</td>
<td>58.8 y</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Processing tomato yields were higher than expected at both sites when no N fertilizer was applied to the tomato crop

At Leamington:
- Overall, processing yields were over 50 t/ac
- Wheat straw treatment had no impact on tomato yield (ripe reds, breakers, processing greens, grass greens, or total processing yield) or percent green

At Ridgetown:
There were two issues at this site.
1) The soil pH was lower than ideal at 5.0. However, there were no deficiency or toxicity symptoms. Plant samples will be sent to Agri-Food Laboratories for complete nutrient analysis. The Ridgetown Campus 2009 tomato site has a pH of 6.3 and 1.3% organic matter.
2) On Tuesday 10th June at 8.45 a.m. the range south of our tomato plot was sprayed by another research group with Buctril M (bromoxynil/MCPA) using Al low drift tips. The technician “thought winds were calm enough, moving west to east and the spray direction was north / south”. Damage was likely due to vapour drift and not chemical spray drift directly on the crop. The tomato rows immediately beside the wheat were injured and symptoms decreased the further away from the sprayed field. On Friday 13th June, we hosted the World Tomato Congress and several board members saw the field – plants were small and injury was not visible from the wagons. The plan was to replant on Monday, but over the weekend the plants recovered and were showing new growth even on the most injured plants. After consultation with Darren Robinson and others, the decision was made not to replant. Within two to three weeks, you could no longer see any difference over the trial.
- Despite these issues, total yields were respectable at over 30 t/ac.
- Both red and total tomato yields were significantly lower when straw was removed compared to adding fall N to the straw. Leaving the straw in the field without added N resulted in intermediate yields.
- The number of rots was higher with wheat straw removed compared to leaving the straw in the field and adding fall N to the straw.
Ethrel® was not used, so each plot was harvested when tomatoes reached 80% red ripe. There was no difference in percent greens between wheat straw treatments, but there was a higher percent green fruit when N was applied to the tomato crop compared to zero N at 7% and 4%, respectively (data not shown).

SOIL MOISTURE AND TEMPERATURE:
- At Ridgetown before planting, soil moisture was slightly lower with straw removed (ave 15.4) compared to the other two wheat treatments (ave 17.6 and 17.5).
- At Ridgetown before planting, soil temperature was slightly higher (ave 13.1) with straw removed compared to the other two wheat treatments (ave 12.9 and 12.9°C).
- It is doubtful that these difference would have a large impact on planting operations.
- At Leamington, no difference between wheat treatments in soil temperature or moisture.

QUALITY (Table 3):

Table 3. Impact of winter wheat management and N fertilizer on processing tomato quality.

<table>
<thead>
<tr>
<th>Wheat residue treatment</th>
<th>Agtron</th>
<th>Soluble solids</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RC</td>
<td>Leamington</td>
<td>RC</td>
</tr>
<tr>
<td>No treatment – straw left in field</td>
<td>20.0 a</td>
<td>6.16 b</td>
<td>4.69 a</td>
</tr>
<tr>
<td>Straw removed</td>
<td>19.8 a</td>
<td>6.78 c</td>
<td>4.66 a</td>
</tr>
<tr>
<td>Straw left + fall N</td>
<td>19.6 a</td>
<td>6.25 b</td>
<td>4.65 a</td>
</tr>
<tr>
<td>Zero N on tomatoes</td>
<td>20.2 z</td>
<td>5.37 y</td>
<td>4.282 z</td>
</tr>
<tr>
<td>N on tomatoes</td>
<td>19.4 y</td>
<td>5.69 z</td>
<td>4.269 y</td>
</tr>
</tbody>
</table>

- Agtron colour was very good at both sites. Wheat treatment had no impact on colour.
- At the Leamington site, wheat treatment had no impact on soluble solids.
- At the Ridgetown site, soluble solids were unusually high. The lack of rainfall in August and the low water holding capacity of the site resulted in small fruit size and higher than expected blossom end rot (data not shown).
- Regardless of the treatment all tomato juice pH values were within the threshold for safety.
- At both sites, nitrogen fertilizer applied to the tomato crop, as expected, delayed maturity compared to no N applied.
- A slight trend toward differences in rate of maturity between wheat straw treatments was observed, but further analyses and more site-years data are required to determine if this effect is significant.
GENERAL 2008 CONCLUSIONS:
At the Leamington site, there was no difference between wheat treatments, because more tillage and the rye cover crop/windbreak likely negated any effects. At Ridgetown, for two contrasting weather years (2007 and 2008), removing the wheat straw lowered yields. Removing wheat straw is not recommended because 1) there was a yield penalty compared to leaving wheat straw in the field 2) and there may an added expense. Fall N applied to straw lowered yields in 2007 but not 2008.