Soil Moisture Conditions and Crop Water Use

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Soil Moisture Conditions and Crop Water Use

Abstract
Soil moisture during the growing season is essential to obtain optimal yield. Optimal yield is affected by the availability of moisture as stored water in the soil profile or timely recharge during rain events. Soil texture, tillage practices, residue cover, drainage and weed control can play a significant role in soil moisture availability. Generally, the no-till system is the most effective practice in conserving soil moisture among other tillage systems, especially during dry periods in rain-fed agricultural areas.

Keywords
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Disciplines
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Soil Moisture Conditions and Crop Water Use

By Mahdi Al-Kaisi, Elwynn Taylor and Roger Elmore, Department of Agronomy

Soil moisture during the growing season is essential to obtain optimal yield. Optimal yield is affected by the availability of moisture as stored water in the soil profile or timely recharge during rain events. Soil texture, tillage practices, residue cover, drainage and weed control can play a significant role in soil moisture availability. Generally, the no-till system is the most effective practice in conserving soil moisture among other tillage systems, especially during dry periods in rain-fed agricultural areas.

Crops need water to uptake nutrients and most importantly to reduce heat stress through the transpiration process. That is where the plant releases water through the leaf openings called stomata. This is the plant's main cooling mechanism.

Evaporation of water from soil and plant surfaces is another source of water loss during the growing season. The two processes together are called evapotranspiration (ET) or crop water use. Crop water use represents both soil evaporation and plant transpiration used for crop growth and cooling purposes.

Potential ET (PET) or Reference ET (ETr) vs. Actual ET (ETa)

Actual evapotranspiration (ETa) or actual crop water use can be estimated or determined if we know potential evapotranspiration (PET) and the correct crop coefficient (Kc) at a certain growth stage for a particular crop. Potential ET - sometimes called reference ETr - is defined as the rate of readily available water removal from wet soil and plant surface under well-watered conditions when moisture availability is not a limiting factor.

To calculate crop water use or ETa:

\[ \text{ETa} = \text{Kc} \times \text{PET} \]

Where, Kc is crop coefficient provided for each crop at different growth stages and PET is potential evapotranspiration provided from weather stations at different growth stages.

The first step in figuring crop water use is to determine PET for the locations of interest. Obtain PET in this way:

1. Go to mesonet.agron.iastate.edu
2. Roll down the page and click on "ISU AgClimate."
3. Click on “Request Daily Data” at the lower right.
4. Choose a weather station close to your area of interest.
5. Select Daily Evapotranspiration (PET) (inch). Also, you can select precipitation for comparison.
6. Select date: For example, you can use June 1 to June 30, 2012, to...
obtain your PET values. Separate values by TABS.

7. Punch “Get Data.”

Or to get PET from yesterday, select: http://mesonet.agron.iastate.edu/agclimate/display.php?prod=6

Once you have PET, use Table 1 to estimate corn water use based on the current corn growth stage matched with the present PET.

Table 1. Estimation of corn water use for Iowa based on potential daily evapotranspiration (PET) at different crop developmental stage (Dev. Stage).

<table>
<thead>
<tr>
<th>Corn Stage</th>
<th>Kc</th>
<th>0.1</th>
<th>0.15</th>
<th>0.2</th>
<th>0.25</th>
<th>0.3</th>
<th>0.35</th>
<th>0.4</th>
<th>0.45</th>
<th>0.5</th>
<th>0.55</th>
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<tr>
<td>V1</td>
<td>0.3</td>
<td>0.53</td>
<td>0.05</td>
<td>0.06</td>
<td>0.08</td>
<td>0.09</td>
<td>0.11</td>
<td>0.12</td>
<td>0.14</td>
<td>0.15</td>
<td>0.17</td>
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<td>V4</td>
<td>0.42</td>
<td>0.04</td>
<td>0.06</td>
<td>0.08</td>
<td>0.10</td>
<td>0.11</td>
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<td>0.17</td>
<td>0.19</td>
<td>0.21</td>
<td>0.21</td>
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<tr>
<td>V6</td>
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<td>0.05</td>
<td>0.08</td>
<td>0.11</td>
<td>0.13</td>
<td>0.16</td>
<td>0.19</td>
<td>0.21</td>
<td>0.24</td>
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<td>0.10</td>
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<td>0.29</td>
<td>0.32</td>
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<tr>
<td>V10</td>
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<td>0.15</td>
<td>0.19</td>
<td>0.23</td>
<td>0.27</td>
<td>0.31</td>
<td>0.34</td>
<td>0.38</td>
<td>0.42</td>
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<tr>
<td>V12-RS</td>
<td>0.80</td>
<td>0.09</td>
<td>0.12</td>
<td>0.18</td>
<td>0.22</td>
<td>0.26</td>
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<td>0.40</td>
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<tr>
<td>RS</td>
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<td>0.30</td>
<td>0.34</td>
<td>0.38</td>
<td>0.42</td>
</tr>
</tbody>
</table>

† Kc = Iowa crop coefficient for corn estimated by Elwynn Taylor from previous research and experience.

‡ 0.55 inch of water loss of Potential ET may result when there is no water limitation or availability concerns. This high level may not be applicable to Iowa conditions since PET is affected by many factors and it is area specific. It serves here as a reference point that can be used for calculating crop water use.

For more information on Crop Water Use, see: http://www.ipm.iastate.edu/ipm/icm/2000/5-29-2000/wateruse.html.

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