University of California

Insights: Water & Drought Online Seminar Series

Hosted by:
University of California, Agriculture and Natural Resources
California Institute for Water Resources
& Strategic Water Initiative

Organized by:
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Managing corn under California’s drought conditions

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Outline

• General principles of water productivity under water deficits
• Water use by irrigated corn in California
• Key management decisions related to water productivity
• Grain corn vs silage corn; alternatives to corn
• Irrigation system design
• Conservation agriculture
More crop per drop: water productivity

Fig. 1. Generalized relationships between applied irrigation water, ET, and crop grain yield. $I_W$ indicates the point beyond which the productivity of irrigation water starts to decrease, and $I_M$ indicates the point beyond which yield does not increase any further with additional water application.

More crop per drop: water productivity

Adapted from: Farre and Faci. 2006. Ag. Water Mgt.
More crop per drop: water productivity

Adapted from: Farre and Faci. 2006. Ag. Water Mgt.
Water use by irrigated corn in California

![Graph showing cumulative evapotranspiration (ET) over time with values of 29 inches and 23 inches.](graph.png)
Planting date affects corn water use

Adapted from: Schwankle and Fulton. Corn ET Estimates:
Planting date affects corn water use
Variety choice affects water productivity

Variety choice affects water productivity

In-season management

Cumulative evapotranspiration, ET (inches)

1-May 31-May 30-Jun 30-Jul 29-Aug 28-Sep
In-season management

Emergence to V5
- weed control
- salinity

Cumulative evapotranspiration, ET (inches)

Image courtesy: Purdue University
http://extension.entm.purdue.edu/fieldcropsipm/corn-stages.php
In-season management

Late vegetative – early reproductive
• most drought-sensitive period
• avoid moisture stress

Cumulative evapotranspiration, ET (inches)

Image courtesy: Purdue University
http://extension.entm.purdue.edu/fieldcropsipm/corn-stages.php
In-season management

Grain filling – maturity
- water stress will reduce yields
- delay stress as long as possible
In-season management

Grain filling – maturity
- 50% milkline for silage
- < 30% milkline for grain
- black line = physiological maturity

Image courtesy: University of Kentucky
In-season management: Review

There is never a good time to water-stress corn, but some times are worse than others.
Alternatives to corn: sorghum

- Varieties available that harvest for silage 90 to 110 DAP
  - 38 varieties tested in UC program
- 16 to 18 inches ET
- 9.5 to 13.5 inches applied water
- Deeper rooted than corn
- 22 to 28 tons/acre silage
- **BUT:** lower feed quality than corn silage
  - Brown midrib sorghum (BMR) varieties offer better feed quality
  - BMR varieties less drought tolerant
Alternatives to corn: sorghum

Adapted from: Farre and Faci. 2006. Ag. Water Mgt.

http://sorghum.ucanr.edu/
http://alfalfa.ucdavis.edu/

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Alternatives to corn: sudangrass

Flexibility

• Number of cuttings flexible to limited water supplies

• May be green chopped, ensiled, or harvested as hay

• **But:** Be alert to risk prussic acid accumulation
  – Affected by drought
Irrigation system design: Furrow

Concept: Distribution of furrow irrigation water

Begin Irrigation

- Applied water
- Infiltrated water

Ground surface
Irrigation system design: Furrow

Distribution midway through set
Irrigation system design: Furrow

Distribution at the end of the set

For efficient furrow irrigation:

70 - 80% of applied water retained in root zone

More water retained in root zone

Water percolation past root zone

Potential for slight deficit and less yield in low quarter of field
Irrigation system design: Furrow

Distribution at the end of the set

For inefficient furrow irrigation:

50% or more of applied water can be lost below the root zone

Water retained in root zone

Water percolation past root zone
Irrigation system design: Overhead

2009 WSREC Trial

- Overhead Season Total = 20.13 inches; 57 irrigation events

- Furrow Season Total (3 acres) = 32.76 inches; 11 irrigation events

- Tradeoff = £
Irrigation system design: SDI

- Water savings versus Overhead
- Opportunities for rotations with tomatoes and other largely SDI crops in California?
- Drawback: expense

Conservation Agriculture for improved water productivity

<table>
<thead>
<tr>
<th>Tillage</th>
<th>No-Till</th>
<th>-Residue</th>
<th>+Residue</th>
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<tbody>
<tr>
<td>% Soil moisture loss (following tillage or 1-2 weeks of residue)</td>
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- **No-tillage** reduces evaporative losses $\approx \frac{1}{2} - 1$ inch
- **Residue retention** reduces evaporative losses $\approx 2 - 4$ inches

% Soil moisture loss (following tillage or 1-2 weeks of residue)
Summary

• Water limitations will reduce the productivity of a corn crop

• However, careful consideration of:

1) Variety choice
2) Planting date
3) Tillage practices
4) Residue management
5) In-season agronomic practices
6) Avoidance of stress at critical periods of development and
7) Irrigation system design and performance

will maximize the productivity of the water that is applied.
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