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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Doug Parker, and Faith Kearns

Managing corn under California's drought conditions

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Jeff Mitchell, UCCE, UCD

University of California
Agriculture and Natural Resources

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

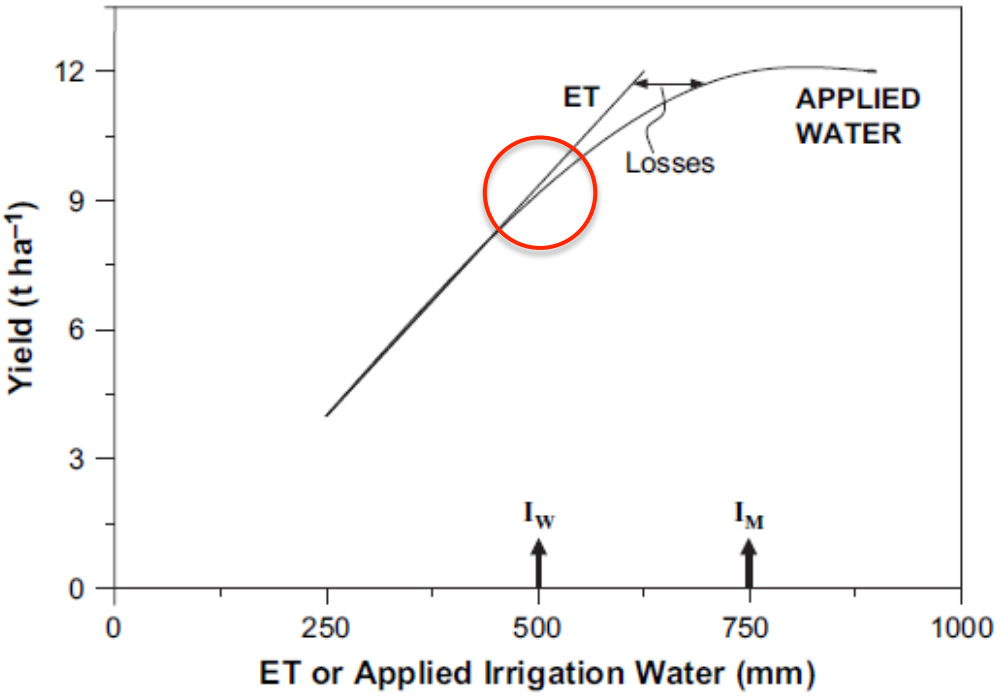
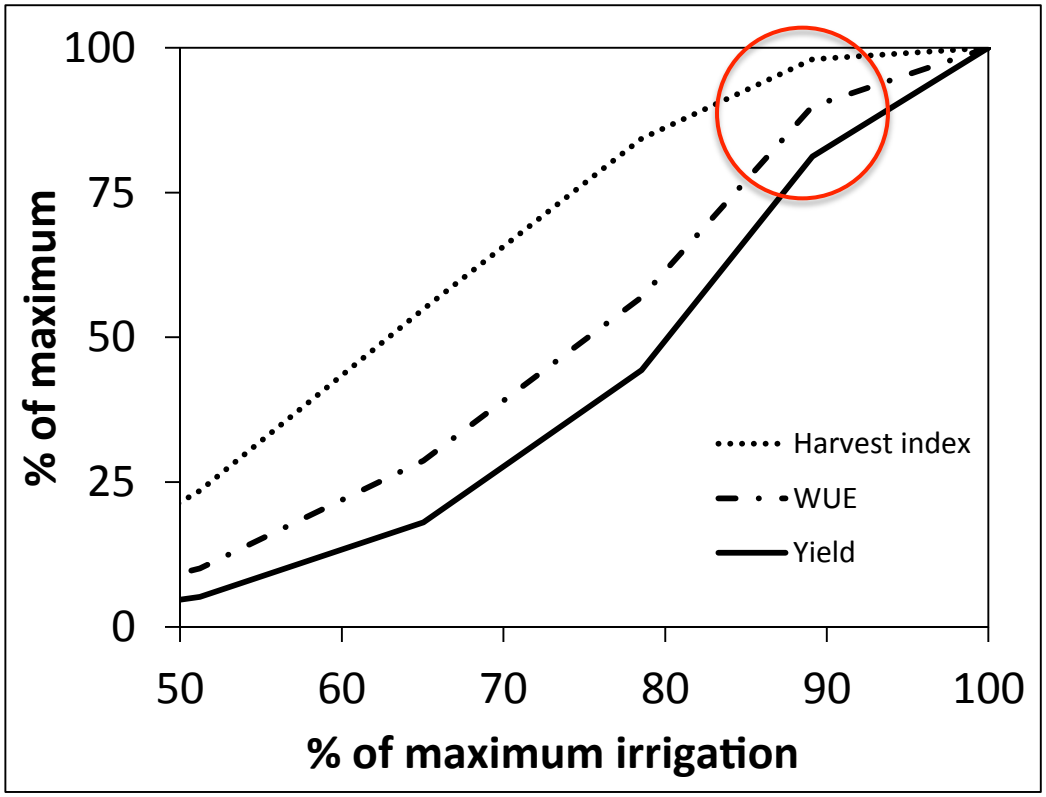


Fig. 1. Generalized relationships between applied irrigation water, ET, and crop grain yield. I_W indicates the point beyond which the productivity of irrigation water starts to decrease, and I_M indicates the point beyond which yield does not increase any further with additional water application.

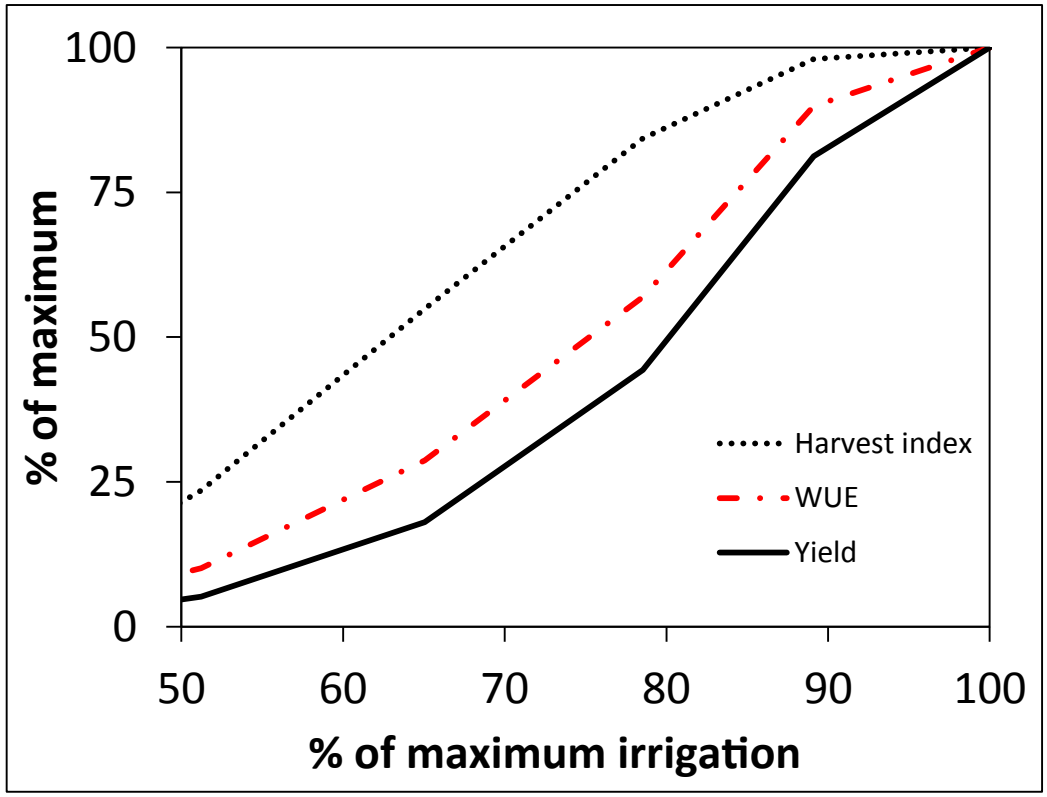
Fereres and Soriano. 2007. J. Exp. Bot.

More crop per drop: water productivity



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

More crop per drop: water productivity



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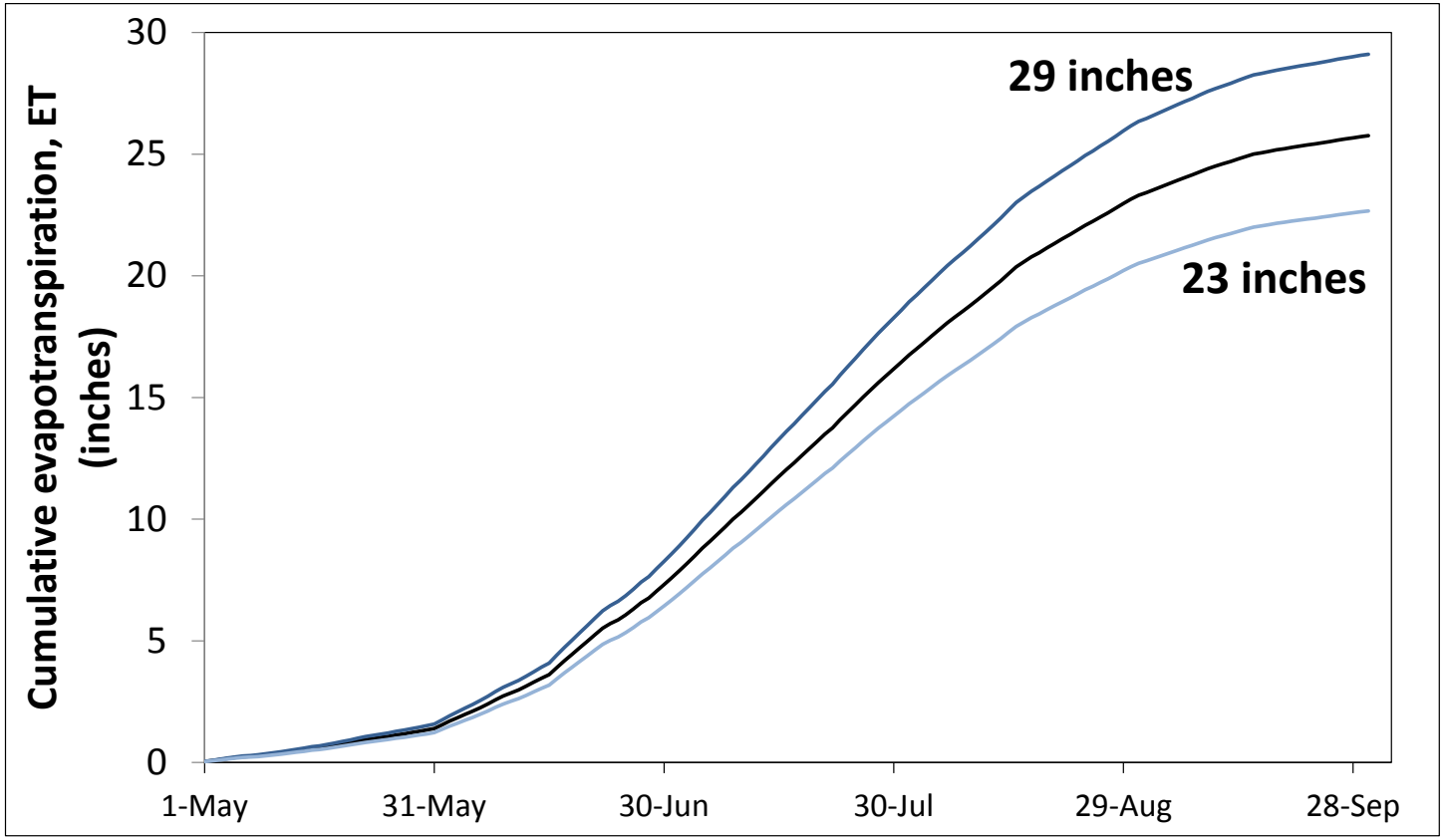
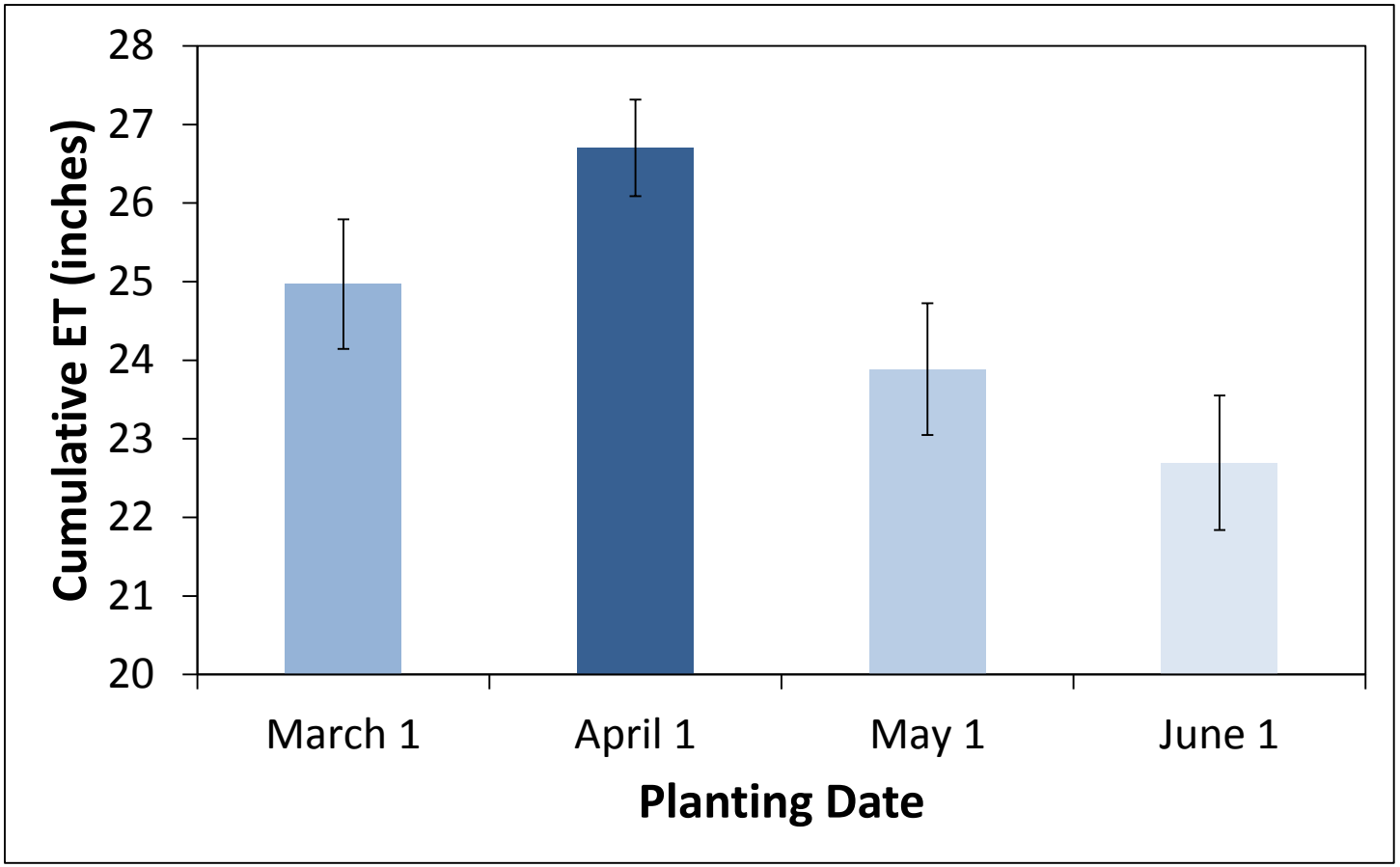
Water use by irrigated corn in California

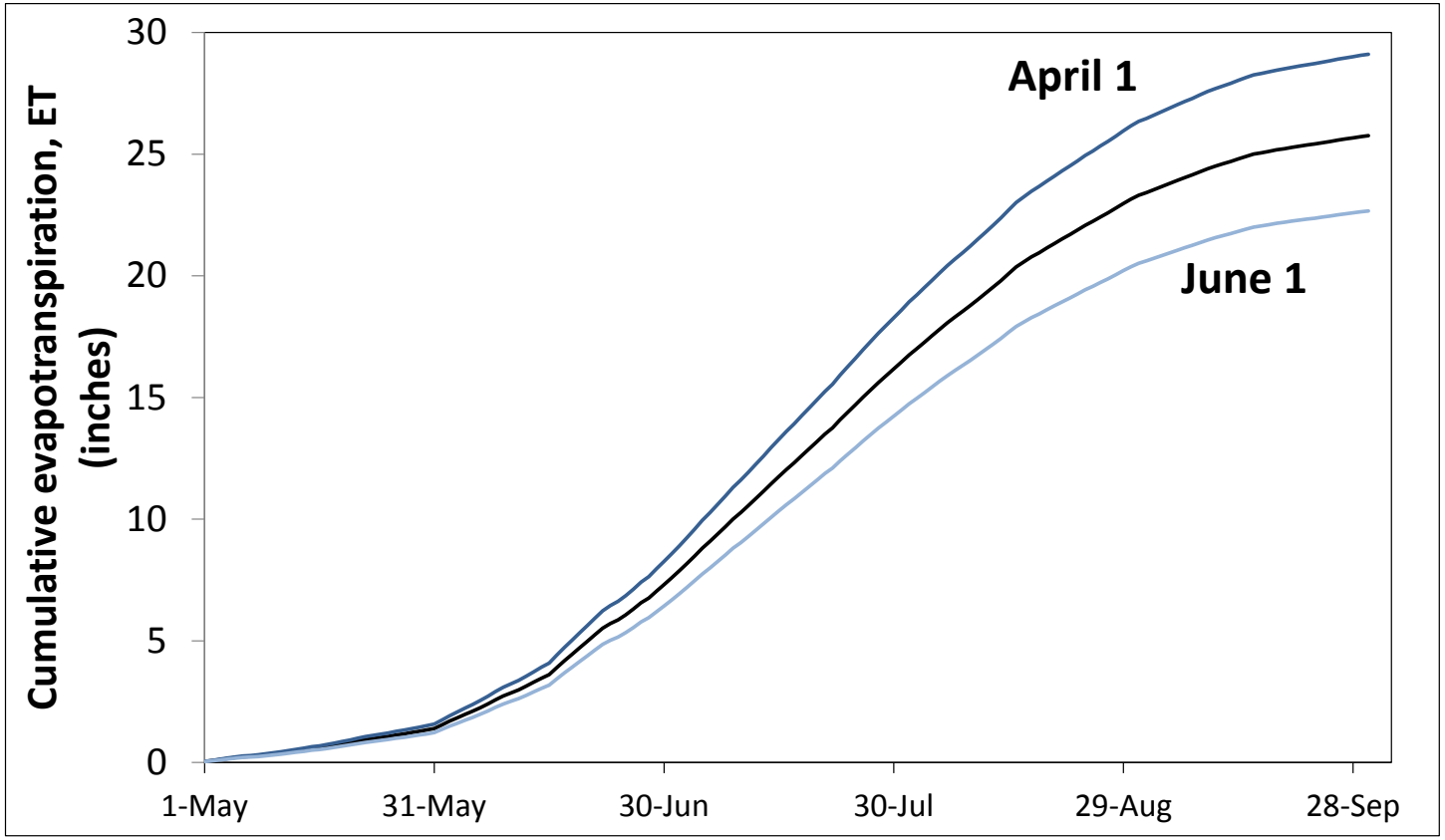


Planting date affects corn water use

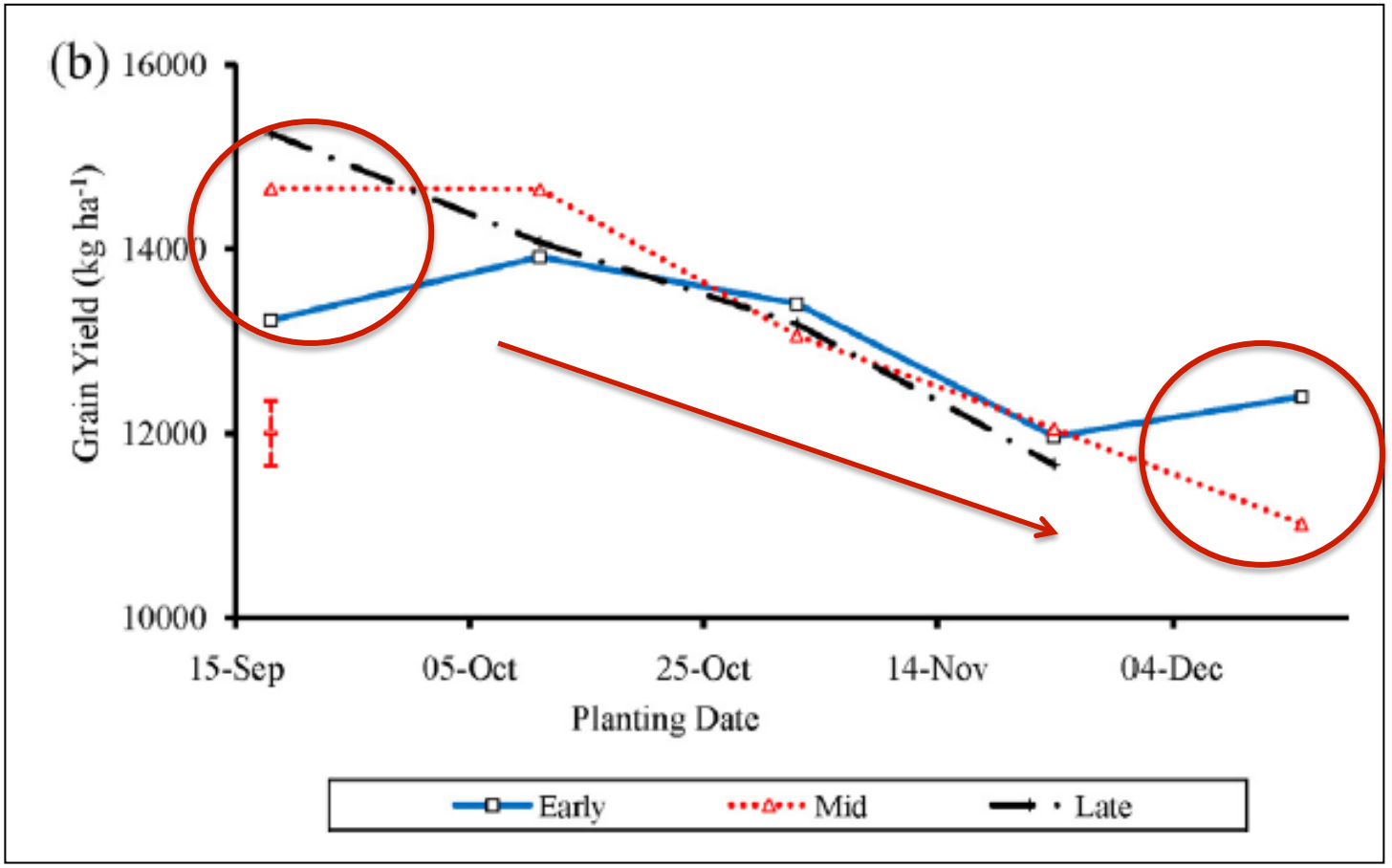


Adapted from: Schwankle and Fulton. Corn ET Estimates:
http://ucanr.edu/sites/Drought/files/167003.pdf

Planting date affects corn water use

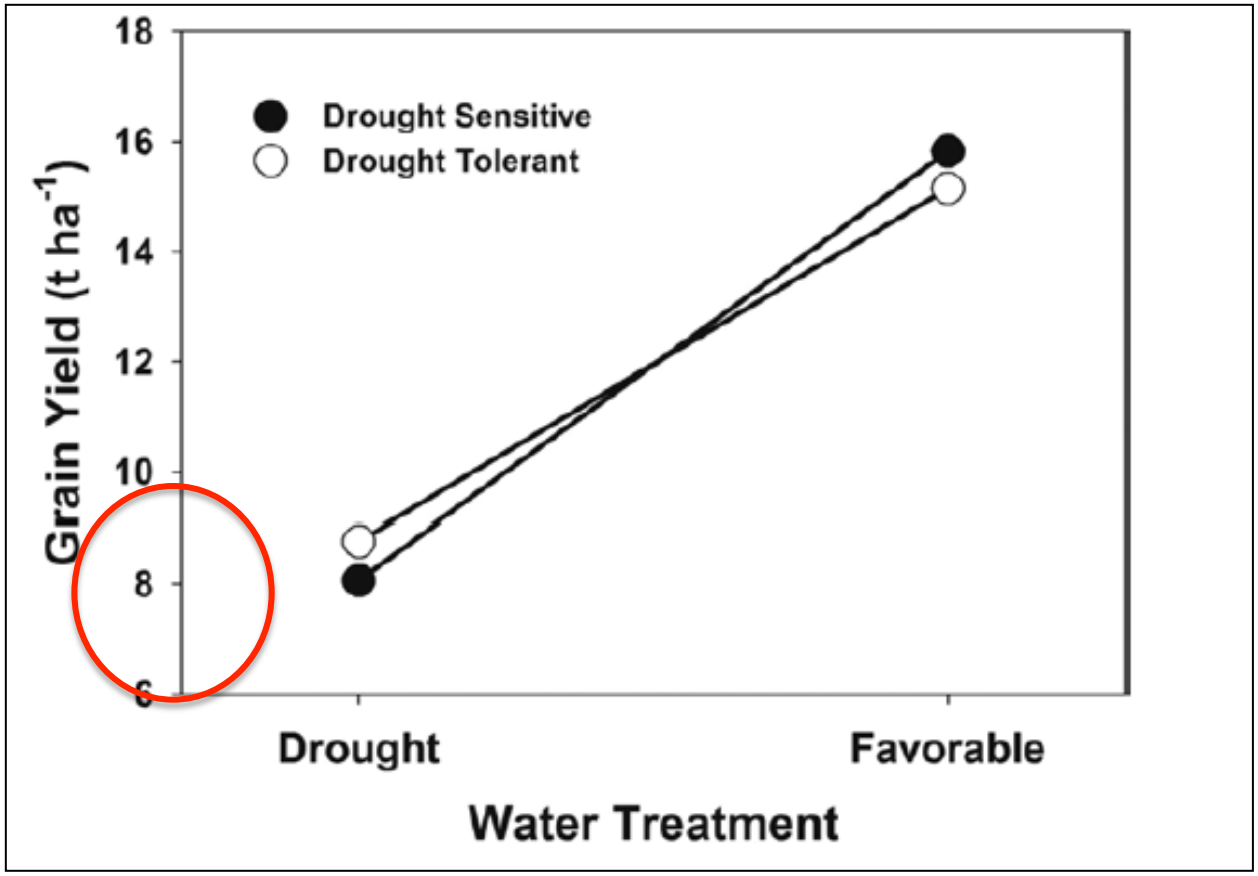


Variety choice affects water productivity



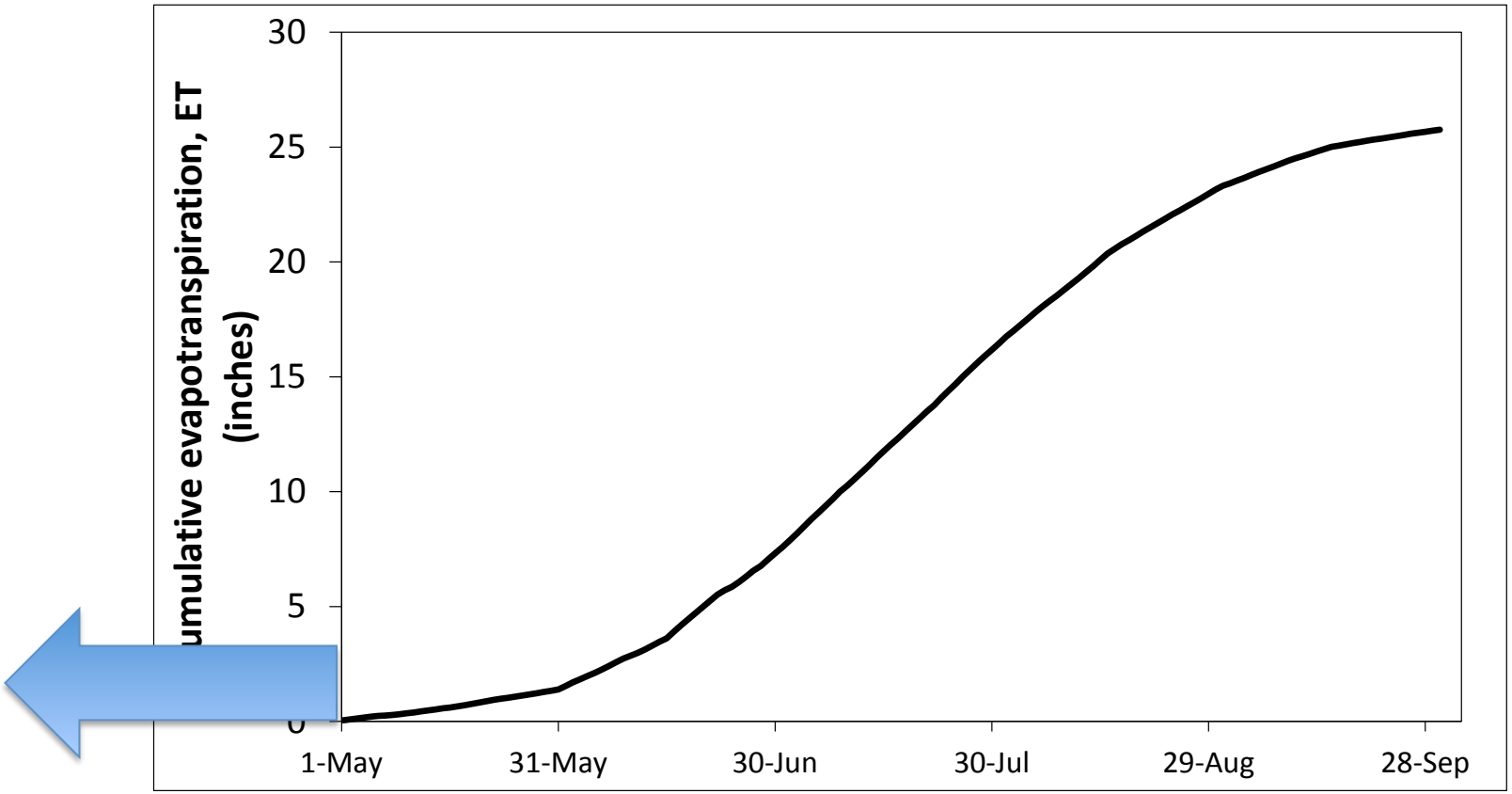
Tsimba et al. 2013. Field Crops Res.

Variety choice affects water productivity



Cooper et al. 2014. J. Exp. Bot.

In-season management



In-season management

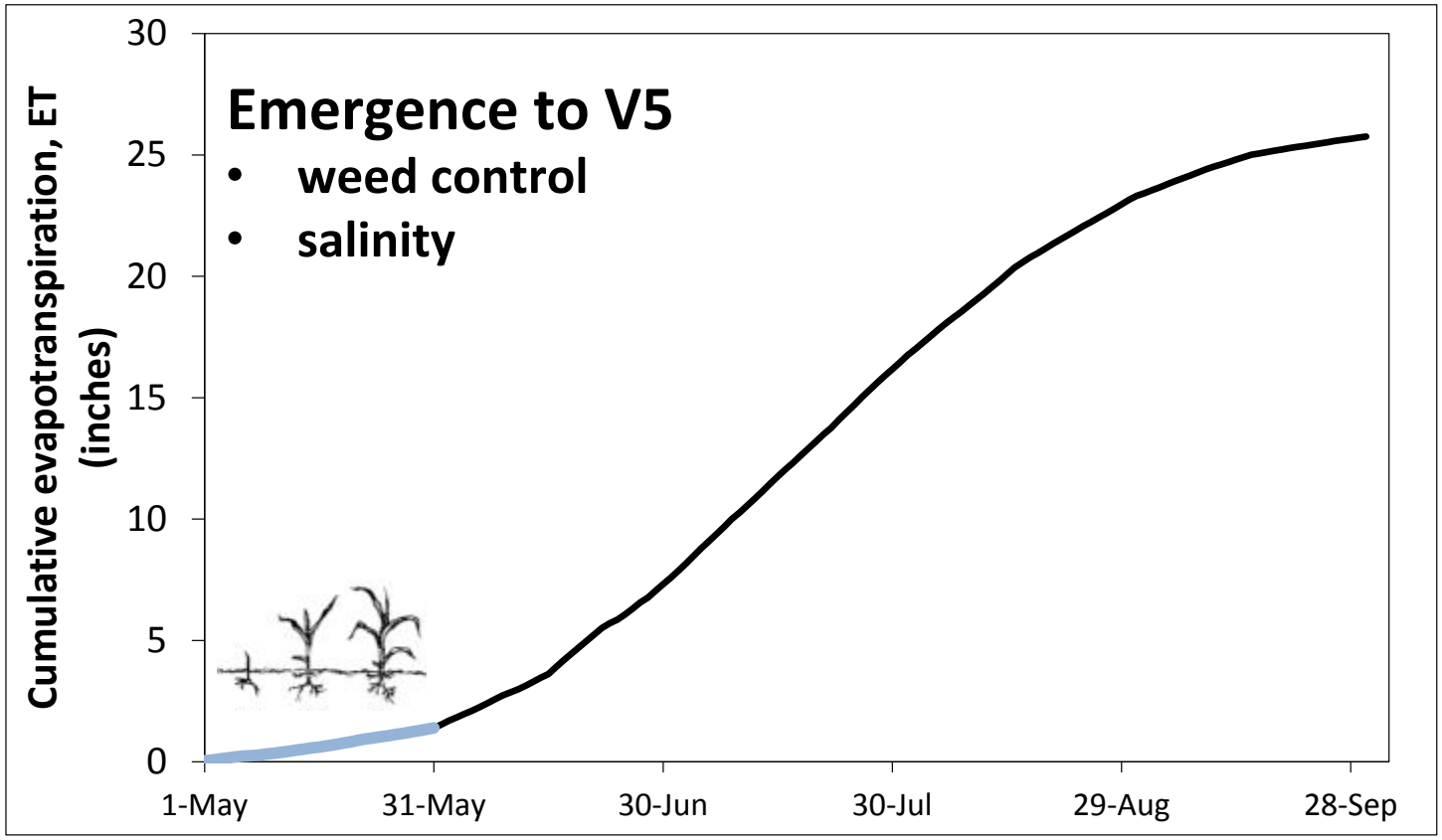
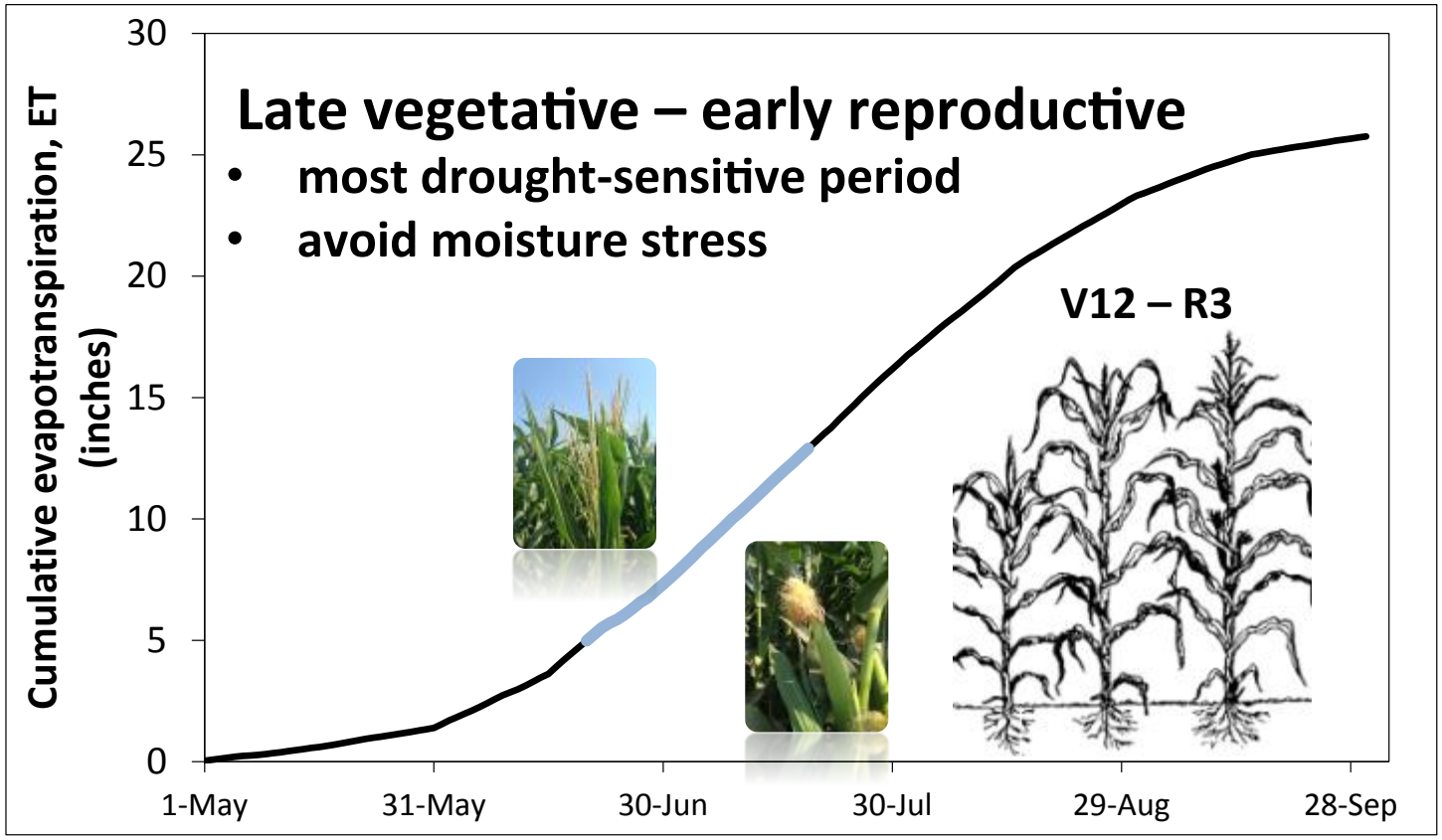


Image courtesy: Purdue University
http://extension.entm.purdue.edu/fieldcropsipm/corn-stages.php

In-season management



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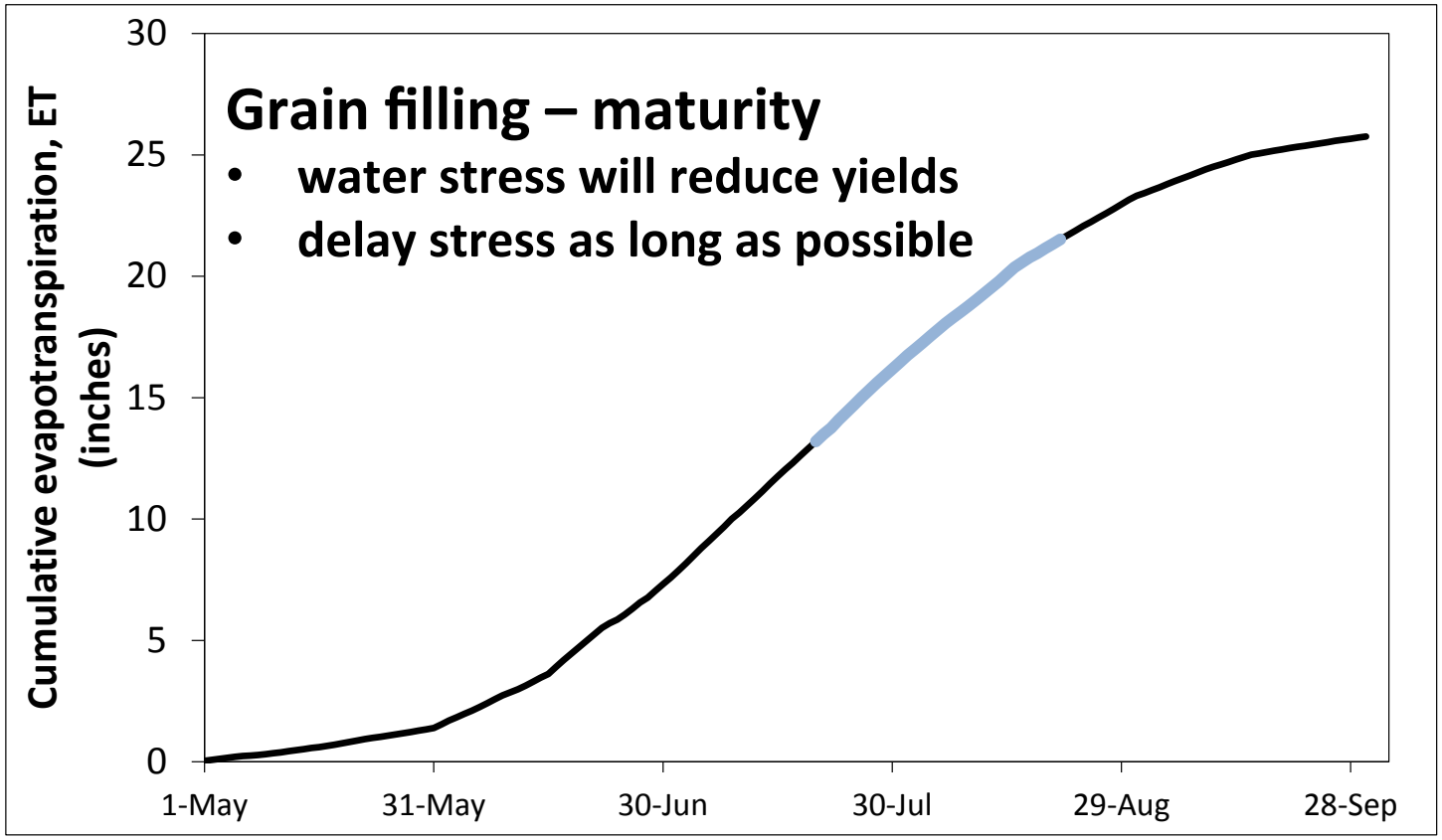

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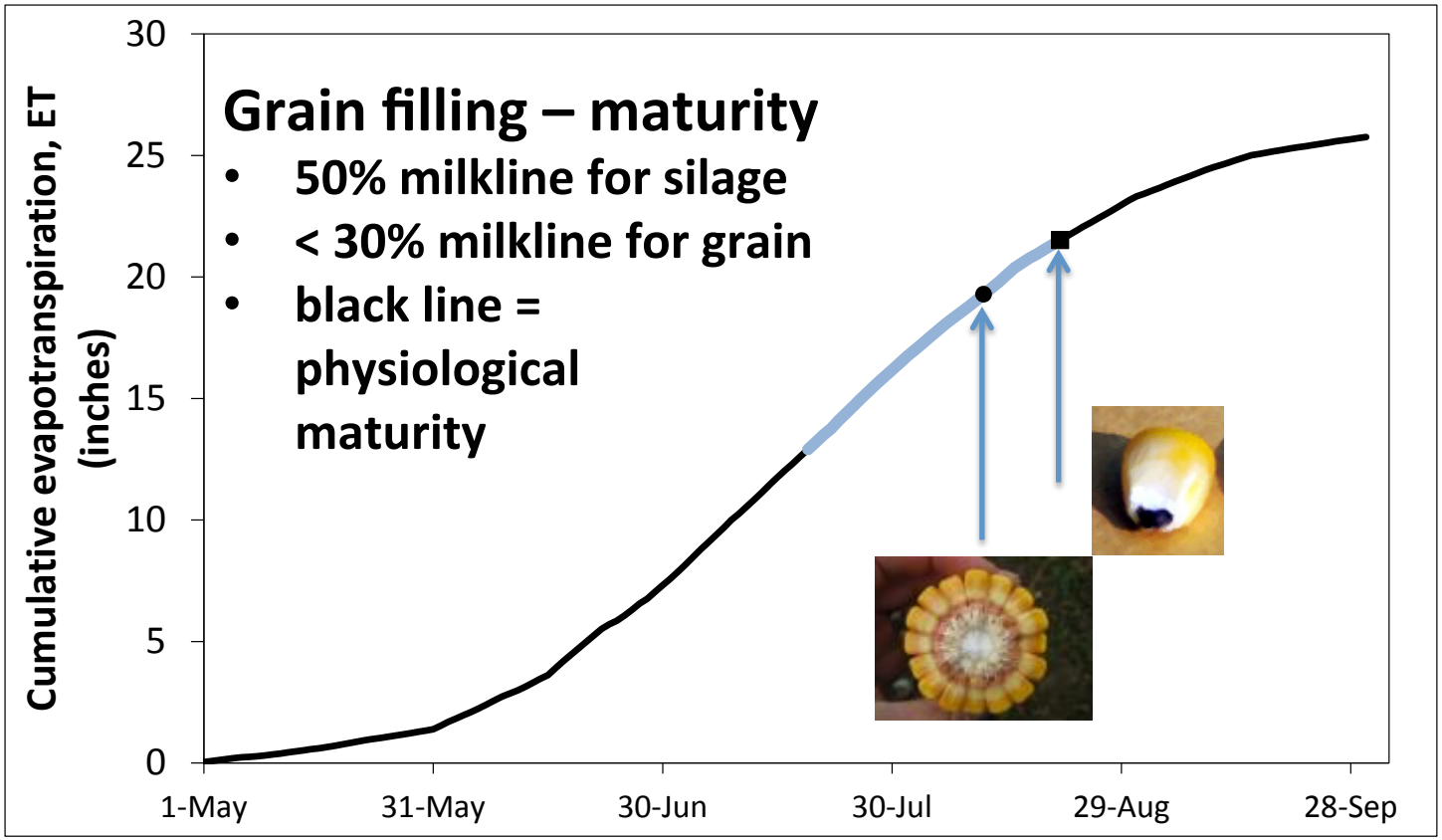
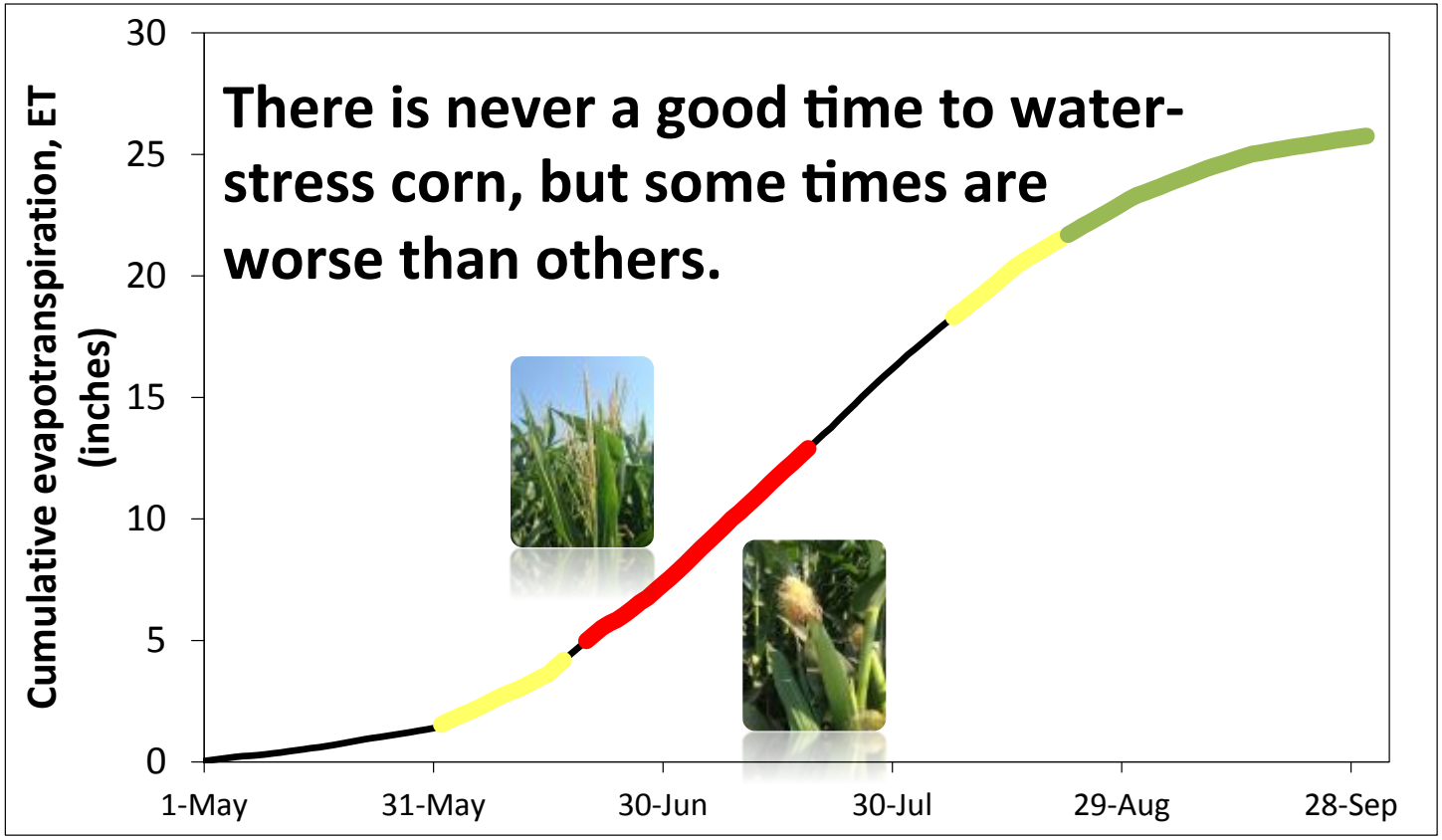


Image courtesy: University of Kentucky

http://grainreps.blogspot.com/2009/10/early-frost-and-potential-yield-losses.html

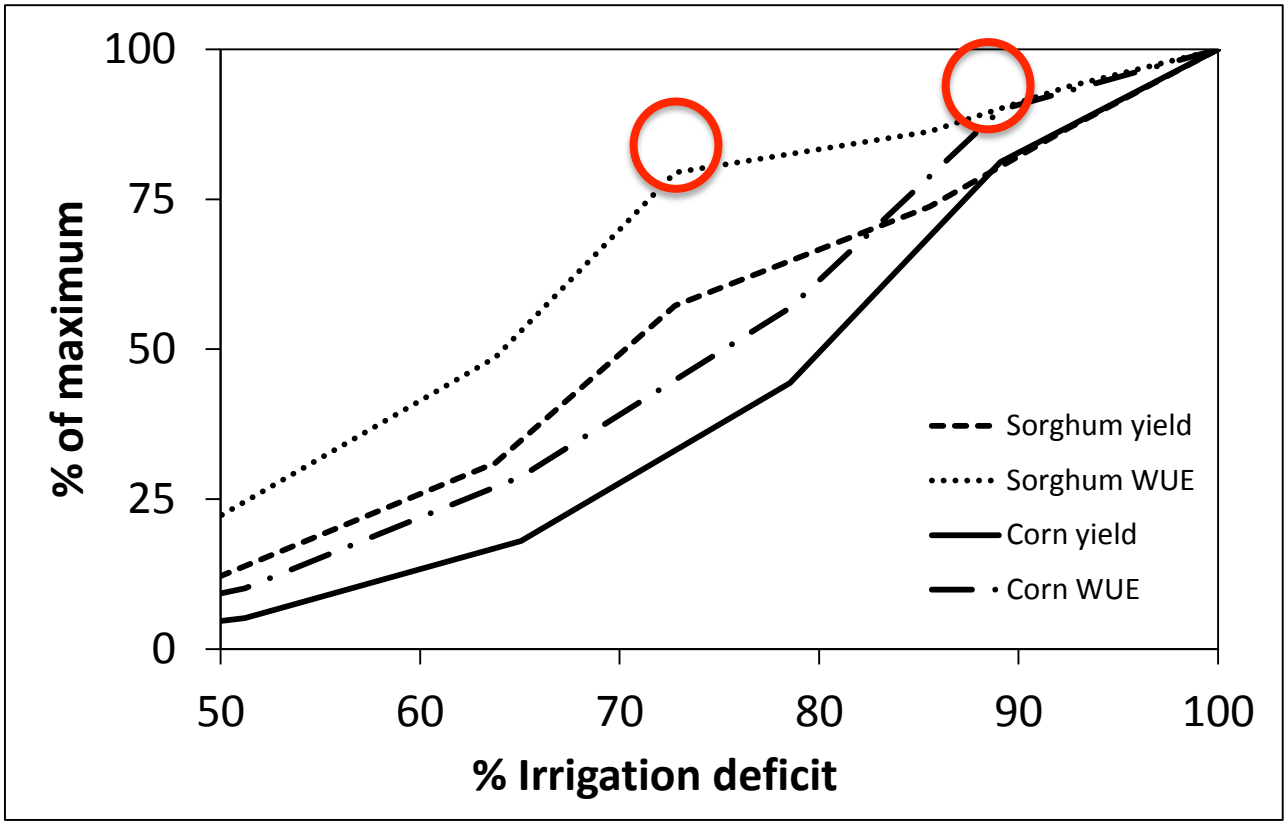
In-season management: Review



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/

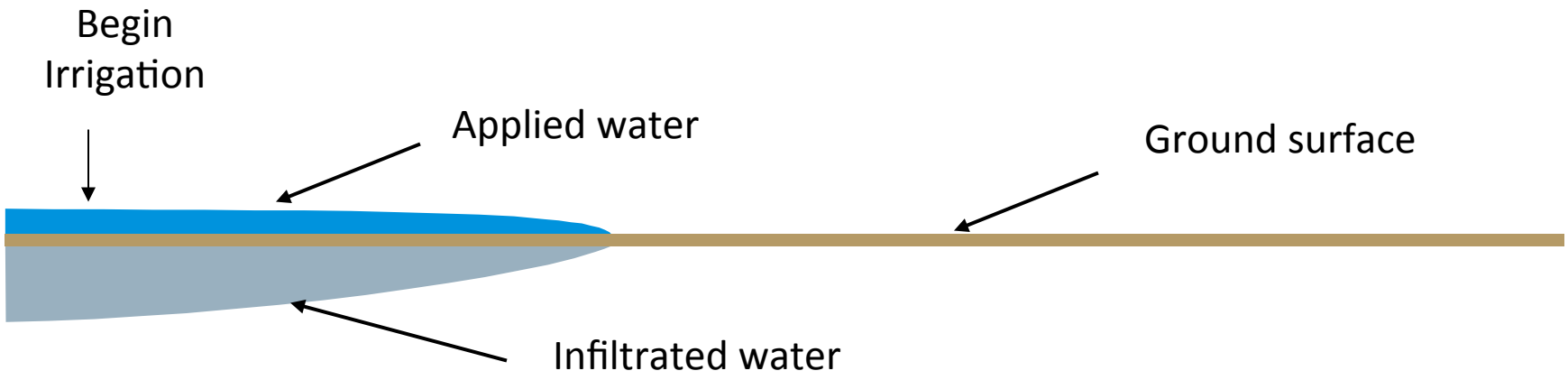
Alternatives to corn: sudangrass

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

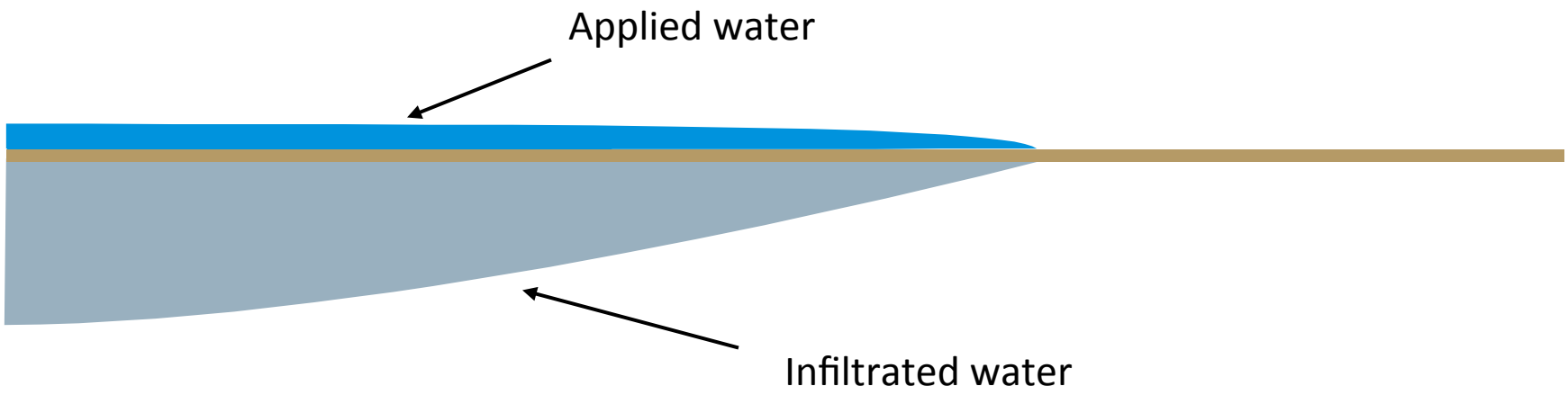
Irrigation system design: Furrow

Concept: Distribution of furrow irrigation water



Irrigation system design: Furrow

Distribution midway through set

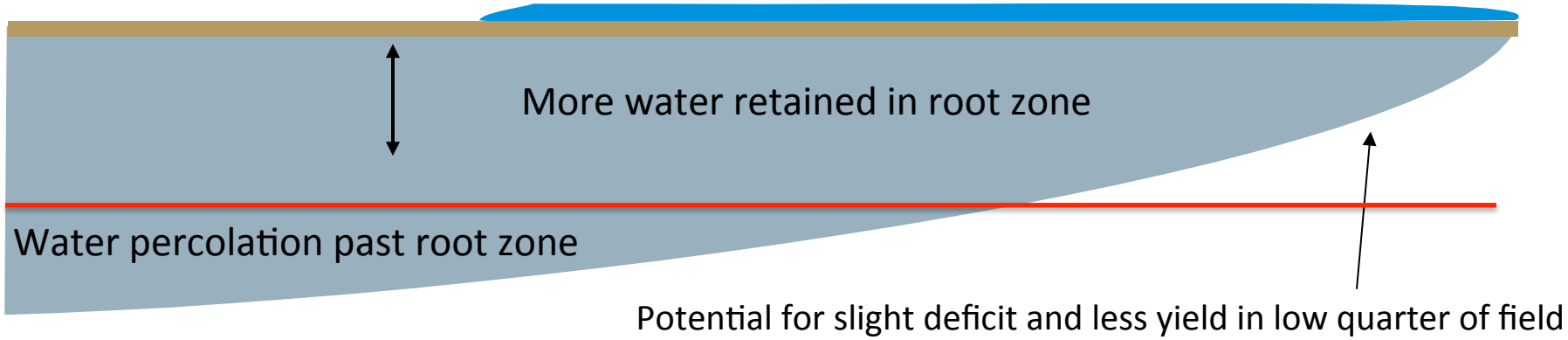


Irrigation system design: Furrow

Distribution at the end of the set

For efficient furrow irrigation:

70 - 80 % of applied water retained in root zone

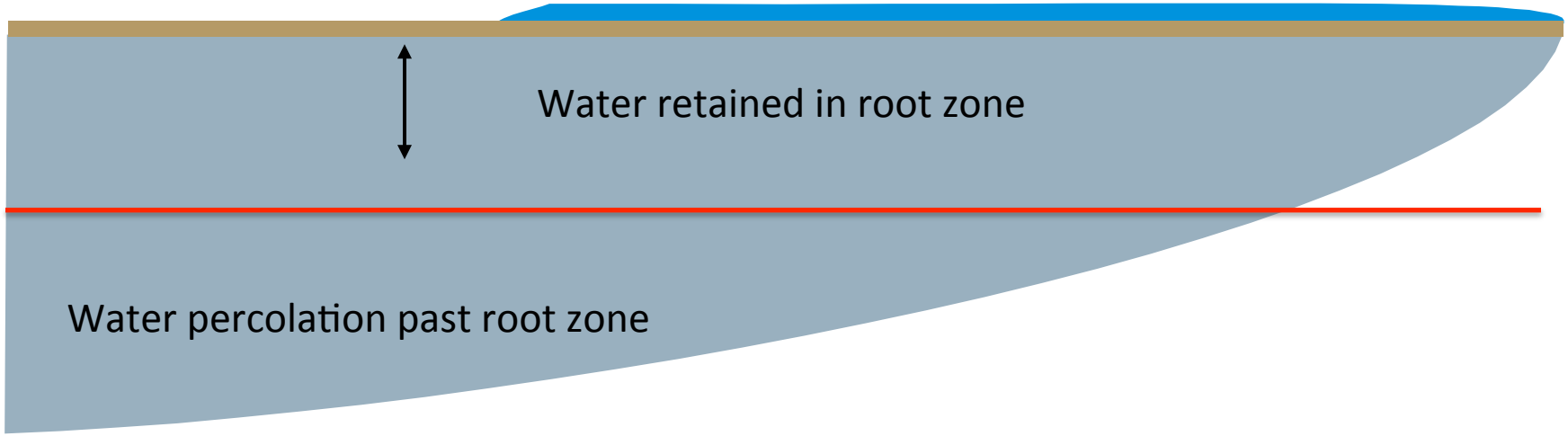


Irrigation system design: Furrow

Distribution at the end of the set

For inefficient furrow irrigation:

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

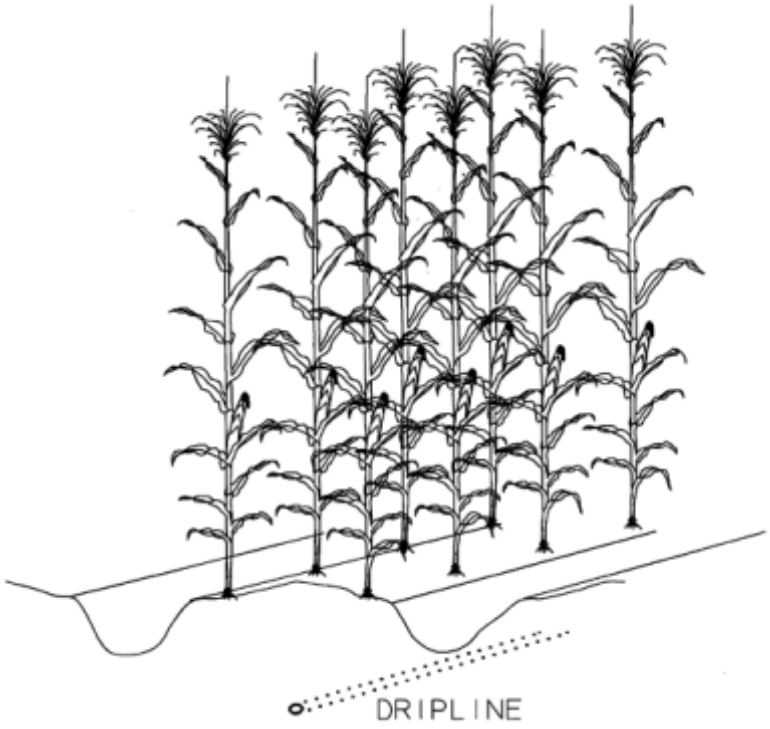


Irrigation system design: Overhead

2009 WSREC Trial

- Overhead Season Total = **20.13** inches; **57** irrigation events
- Furrow Season Total (3 acres) = **32.76** inches; **11** irrigation events
- Tradeoff = $

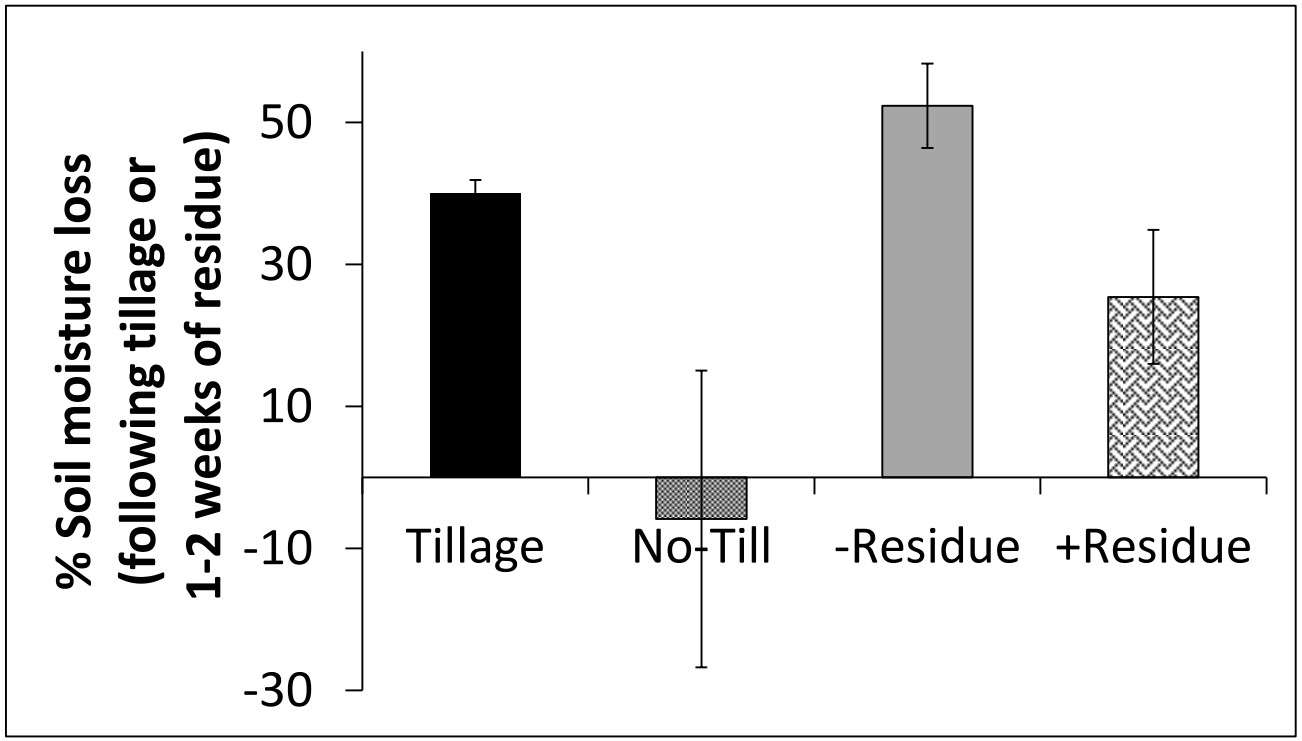
Irrigation system design: SDI



Lamm and Trooien. 2003. Irrig. Sci.

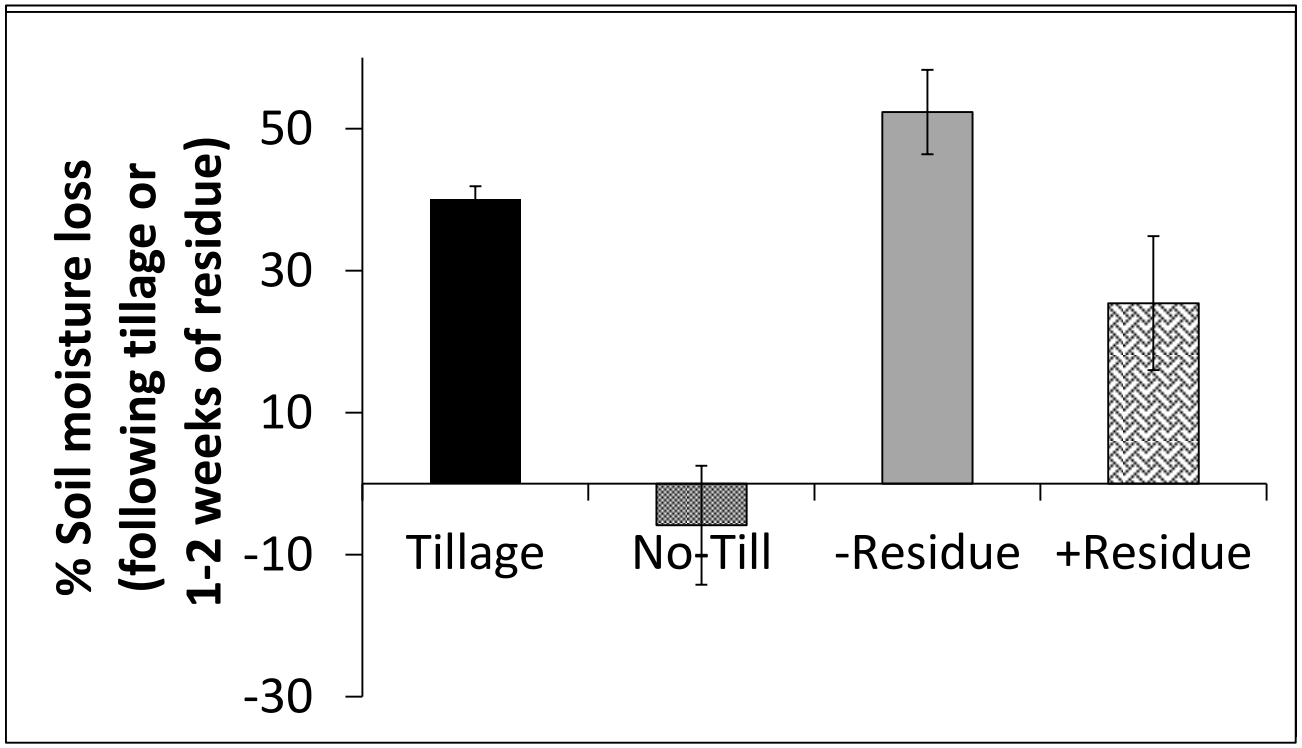
- Water savings versus Overhead
- Opportunities for rotations with tomatoes and other largely SDI crops in California?
- Drawback: expense

Conservation Agriculture for improved water productivity



- **No-tillage** reduces evaporative losses ≈ ½-1 inch
- **Residue retention** reduces evaporative losses ≈ 2-4 inches

Adapted from: Mitchell et al. 2012. Cal. Ag.


% Soil moisture loss
(following tillage or
1-2 weeks of residue)
50
30
10
-10
-30
Tillage
No-Till
-Residue
+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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