Indirect Determination of Leaf Area Index to Calculate Evapotranspiration:

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Organic agriculture
- composted manure
- long-term rotations
- perennials
- improve soil quality

Long-term rotations / perennials
- longer growing season
- longer season water use
- longer season nutrient use
- improve soil quality

Evapotranspiration measure challenge
- need low-cost leaf area index
- varied crops
- incomplete canopy
- dry soil

Goals:
- determine LAI from ground cover + plant height
- use LAI with climate data to determine ET
- compare ET for different rotations

Materials and Methods

Soils
Clarion: Fine-loamy, mixed, superactive, mesic Typic Hapludoll
Webster: Fine-silty, mixed, superactive, mesic Typic Endoaquoll
Canisteo: Fine-silty, mixed, superactive, calcareous mesic Typic Endoaquoll
Harps: Fine-loamy, mixed, superactive, mesic Typic Calciaquoll

Rotations (Cambardella et al., 2015) (Supplement 1, 2)
- conventional corn (*Zea mays* L.) - soybean (*Glycine max* (L.) Merr.)
- 4-year organic: oat (*Avena sativa* L.) + 1st year alfalfa (*Medicago sativa* L.), 2nd-year alfalfa, corn, soybean
- mixed forage

Soil measurements
- Monitoring wells for water table depth
- Neutron probe for soil water content
- Surface soil samples for soil water content
- Soil characterization (soil from neutron probe installation)

Crop measurements (periodic)
- Picture from camera on pole ~6.5 m above ground (Fig. 1)
- Plant height

Picture processing (SamplePoint, Booth et al., 2006)
- Ground cover green crop
- Total green cover
- Non-green cover
- Soil cover
- Crop and total green LAI from cover + plant height (Supplement 3)
- Compare LAI with LAI-2000
- Interpolate measurement dates

Figure 1. Taking picture above alfalfa plot.

Steps: calculate evapotranspiration (ET) (Supplement 4)
- Weather station: air temperature, net radiation, barometric pressure
- Potential ET (Priestley-Taylor)
- Adjust for less than full canopy and for surface soil wetness
- For crop + weed
- Actual ET: Adjust for root zone soil water
- Crop ET: adjust for green crop cover

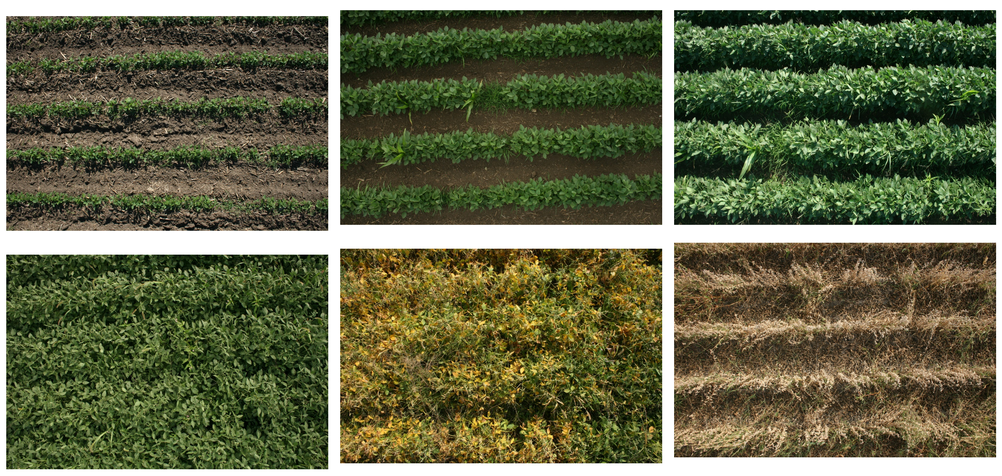

Figure 2. Organic soybean 6/20, 7/12, 7/25, 8/25, 9/12, 9/25/17. Note that data from 9/25/17 was not included on poster.

Results

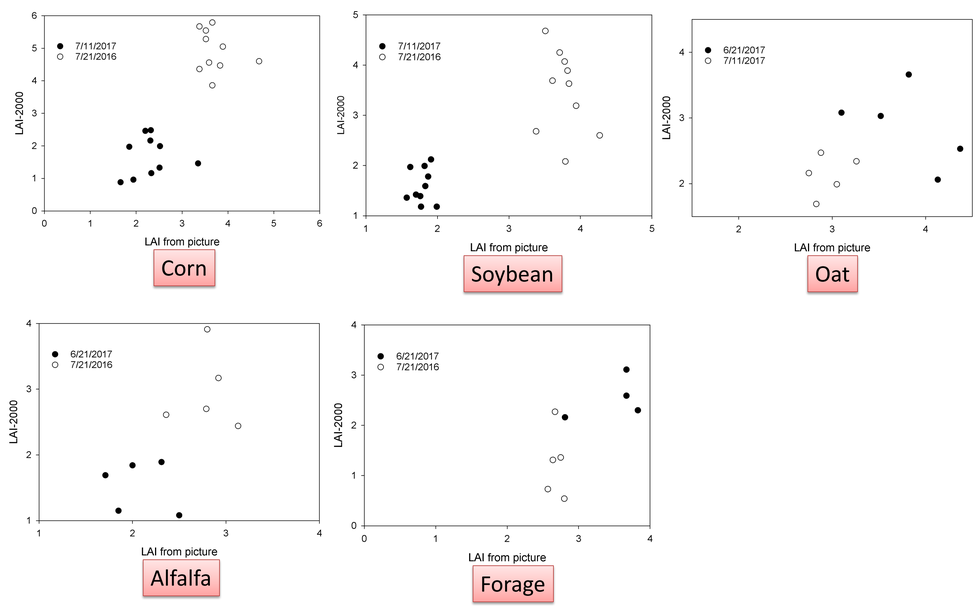

Figure 3. Comparison of LAI from picture and plant height versus LAI-2000.

Table 1. Calculated potential ET.

Time period	Organic 4-yr rotation	Organic forage	Conventional corn/soybean
	mm	mm	mm
6/28-7/19/16	69a	65a	67a
7/20-8/8/16	67b	68b	82a
8/9-8/28/16	63c	69b	77a
8/29-9/17/16	55b	64a	62a
9/18-10/7/16	17b	49a	5c
4/26-5/15/17	13b	60a	0c
5/16-6/4/17	25b	83a	0c
6/5-6/24/17	44b	104a	2c
6/25-7/14/17	71a	60ab	53b
7/15-8/3/17	63b	48b	86a
8/4-8/23/17	59b	51b	82a
8/24-9/12/17	54b	54b	73a

Table 2. Calculated actual ET.

Time period	Organic 4-yr rotation	Organic forage	Conventional corn/soybean
	mm	mm	mm
6/28-7/19/16	66a	62a	62a
7/20-8/8/16	64b	65b	77a
8/9-8/28/16	61c	67a	72b
8/29-9/17/16	53c	62a	59b
9/18-10/7/16	17b	47a	5c
4/26-5/15/17	12b	58a	0c
5/16-6/4/17	24b	79a	0c
6/5-6/24/17	41b	99a	2c
6/25-7/14/17	66a	55ab	49b
7/15-8/3/17	59b	41b	78a
8/4-8/23/17	53b	41b	70a
8/24-9/12/17	47ab	42b	58a

Table 3. Calculated crop ET.

Time period	Organic 4-yr rotation	Organic forage	Conventional corn/soybean
	mm	mm	mm
6/28-7/19/16	59a	61a	59a
7/20-8/8/16	52c	63b	73a
8/9-8/28/16	48c	58b	69a
8/29-9/17/16	46b	52a	56a
9/18-10/7/16	13b	47a	5c
4/26-5/15/17	9b	54a	0c
5/16-6/4/17	21b	77a	0c
6/5-6/24/17	38b	96a	2c
6/25-7/14/17	57a	55ab	43b
7/15-8/3/17	46b	41b	71a
8/4-8/23/17	37b	41b	67a
8/24-9/12/17	32b	42b	56c

Data Summary

- LAI-2000 excessive range of data (Figure 3)
- Dry early 2016 and most 2017 (Supplement 5, Tables 1, 2)
- Forage and 4-year rotation use more water in spring and fall (Tables 1,2, 3)
- Corn - soybean often use more water July + August (Tables 1, 2, 3)

References

Booth, D.T., S.E. Cox, and R.D. Berryman. 2006. Point sampling digital imagery with 'Samplepoint'. Environ. Monitor. Assess. 123:97-108.

Cambardella, C.A., K. Delete, and D.B. Jaynes. 2015. Water quality in organic systems. Sustain. Ag. Res. 4(3):60-69.