Photosynthesis of maize and alfalfa during daytime sprinkler irrigation

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Some water is lost during a sprinkler irrigation event due to wind drift and evaporation (WDEL) that occurs as water travels from the sprinkler nozzles to the crop, and to evaporation that occurs for water intercepted by stems and leaves after the irrigation event.

Nighttime sprinkler irrigation usually results in lower WDEL (9%) compared with daytime irrigation (20%).

Due to WDEL daytime sprinkler irrigation modifies the microclimatic conditions within the crop canopy which could result in improved crop growth.
3.3 – 4.4 ºC
1.0 – 1.2 kPa
4.3 – 6.1 ºC
58 %
0.66 – 0.86 MPa

CHANGE
Positive
Positive
Positive?
Positive
Positive

(Cavero et al., 2009)
To quantify how photosynthesis is affected by daytime sprinkler irrigation in two field crops: maize (*Zea mays* L.) and alfalfa (*Medicago sativa* L.).
Two experiments: one for maize and another for alfalfa.

Maize

- Cultivar: Pioneer PR34N43.
- Sowing date: April 2009.
- Plant density: 85,000 plants ha\(^{-1}\); rows, 0.75 m.

Alfalfa

- Cultivar: Aragon
- Crop year: 2nd.

Crop water requirements, weekly. \(ET_c = Kc \times ET_0\).
- \(ET_0\), standard weather station over grass (FAO PM).
- \(Kc\), crop coefficient.

Irrigation applied = \((ET_c - P_{eff}) + WDEL\)
- \(P_{eff}\), effective precipitation.
MEASUREMENTS

✓ Net photosynthesis since one hour before irrigation started until two hours after irrigation finished measured in the irrigated and the non irrigated plots.

✓ Canopy chamber:
  - Area: 0.75m x 1.0m.
  - Height: 0.58m (alfalfa); 2.50m (maize)
  - Automatically close every 15 min during 50 s.

✓ Air CO₂ measured with an IRGA (LI-7000).

✓ Two canopy chamber-IRGA units.

✓ Measurement of internal temperature with a thermocouple.

✓ Five measurement days for each crop.
RESULTS
Maize leaf
Contact angle:
Adaxial = 68°
Abaxial = 52°

Wettable leaf

Alfalfa leaf
Contact angle:
Adaxial = 122°
Abaxial = 113°

Non wettable leaf
The rate of photosynthesis of maize was significantly reduced by 23% during the sprinkler irrigation event and by 20% during the following first hour.

The rate of photosynthesis of alfalfa was slightly increased (not significantly) during the sprinkler irrigation event and during the following first hour.

The reduction of maize photosynthetic rate during sprinkler irrigation was related with the high wettability of the leaves that reduced the CO₂ uptake.

The low wettability of alfalfa leaves precluded any reduction of CO₂ uptake due to sprinkler irrigation.

Daytime sprinkler irrigation of maize should be avoided.