Soil

Gravimetric and Textures

The protocol consists in extracting soil samples at the depths of 2.5, 5, 10, 20, and 30 cm with a constant volume of 125 cm^3 (for depths of 2.5 and 5 cm) and 250 cm^3 (for depths of 10, 20, and 30 cm). The samples are placed in a plastic bag to minimize moisture loss, weighed wet, oven dried for 24 h at 100 ^oC, and reweighed dry to obtain the gravimetric soil (see Figure 1).

Figure 1. Extraction soil simples.

Finally, using the dried soil samples and applying the sieving method, the soil texture in terms of percentages of sand, clay, and silt is determined.

Theta-Probes

Surface soil moisture (0-5cm) is measured vertically using a ML3 ThetaProbe Soil Moisture device. The measurements are uniformly distributed within the corn fields to characterize the spatial distribution of the surface soil moisture.
Simultaneously to the measurements of soil moisture, the surface soil temperature is measured at the same points (see Figure 2).

Figure 2. Surface measurements with theta probe and thermometer.

Temporal ground stations

Ground stations were programmed to collect data every 20 minutes. The stations include sensors of soil moisture, soil temperature, relative humidity and air temperature and a rain gauge. Soil moisture is measured using Campbell Scientific TDR CS616 sensors located horizontally at depths of 2.5, 5, 10, 20, and 30 cm (see Figure 3). One station was located at each of the 5 sites.

Figure 3. Team installing the TDR sensors

Using the gravimetric soil moisture, the measurements from the CS616 sensors were calibrated deriving one equation per site and per depth.

Soil surface roughness

The soil surface roughness was measured using the grid meshboard method. The board was 1.5-m long with grids of 1 cm X 1 cm. Ten surface profiles parallel and perpendicular the rows were measured per site. For fields under bare soil condition, the surface was under smooth conditions and it was not possible to identify the plow lines (Figures 4 and 5).

Figure 4. Use of meshboard

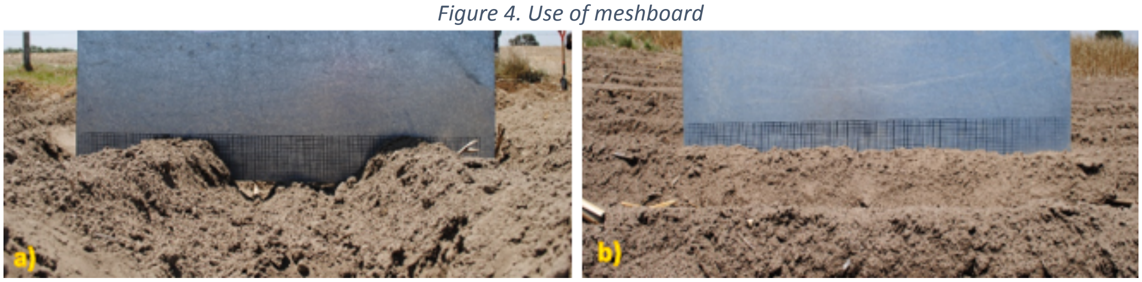

Figure 5. Soil roughness a) perpendicular and b) pararell to the plow

Vegetation

Vegetation properties in three sampling locations were measured every 3 weeks during the complete growing season at each site. A vegetation sampling consisted of measurements of height, width, biomass, LAI, geometric description of the plant, and vertical distribution of moisture in the canopy. The crop density was derived from the stand density and row spacing (76 cm) measured at the first sampling. The height, width, wet and dry biomass, vertical distribution of the moisture in the canopy and geometric description of the crop including maximum length, width of each leaf, stem circumference, pod length, width and thickness of sample plants were measured. Destructive LAI was also being measured.

Geometric description

A geometric description of the plant consisted of the maximum length and width of each leaf of the sample plants, as shown in Figure 6. The stem diameter was measured by using a Vernier caliper to wrap around the base and around the tip of the plant. The ear length was measured while still in the husk from the base of the cob near the stem to the top, and the maximum circumference of the ear was measured by using a Vernier caliper. The stem length and diameter observed are shown in Figure 6. The ear and leaf angles were measured for a single plant taken while still in the field at each sampling area using a protractor. The angle between the leaf and the stem (θ1), the angle of the leaf fold (θ2), and the ear angle (θe) were measured.

Figure 6. Geometry measurement.

Biomass

- Wet and dry biomass

Each sampling included one row of corn in the three sampling locations. The sampling length started between two plants and ended at the next midpoint between plants that was greater than or equal to one meter away from the starting point. Two plants within this length were cut at the base, separated into leaves, stems, and ears, and weighed immediately. The samples were dried in the oven at 60ºC for one week and weighed.

- Height and width

Crop height and width were measured by placing a measuring stick at the soil surface adjacent to the stem up to the maximum height of the crop. The maximum canopy width of the plant (parallel or perpendicular to the row) was also measured. Four representative plants were selected to obtain heights and widths inside each vegetation sampling area. Figure 7 shows the average maximum crop heights and widths during field campaign.

- LAI

Destructive LAI was measured by taking two representative plants (sub-sample) in the sampling area. The leaves and the rest of the plant were dried in an oven at 60°C for one week to measure the dry weight of the leaf, stem, and ears (if present) of the sub-sample. The ratio of the leaf dry weight to the dry weight of the subsample (including leaves) was used to calculate the fraction of leaf (FLEAF) in Equation 1 (Boote 1994). The length and width of each individual leaf of the two plants in the sub-sample were used to estimate area of each leaf assuming an ellipse. The area of the leaves were totaled and divided by the dry weight of the leaves in the sub-sample to calculate the specific leaf area (SLA). The total dry biomass (DM) for the sampling area (around $1m^2$) was found using the procedure in 5.2. Equation 1 was used to determine the destructive LAI.

$$LAI = DM * FLEAF * SLA \qquad (1)$$

where DM is total (leaves +stem + ears) dry biomass in 1 sq m (g/m2), FLEAF is the Fraction of leaf (calculate this for the 2 representative plants), and SLA is specific leaf area. The area of all the leaves of 2 plants assuming each leaf is an ellipse.

Figure 7. Biomass measurements.