Production Priorities Group: Key Decisions

	Nitrogen (N)	Water (capture, use, irrigation)	Genetics	Crop Protection (insects, disease and weeds)
Timing	• Weekly intervals at minimum, all year	• Weekly intervals at minimum, all year	• 1 year in advance	• Throughout growing season
Data Required	• Weather forecast (3-5 months out) • Plant N • N production in soil • Soil texture • Soil organic matter • Manure profile • N losses - leaching, denitrification, volatilization • N in tile line • Temperature	• Infiltration • Plant water use efficiency • Soil water-holding capacity • Soil structure at depth • Root depth • Evapotranspiration • Water in tile line • Canopy temperature • Microbial activity (CO_2)	• Historical yield • Accurate, high-resolution soil maps	• Number, distribution of organisms • Epidemiology; outbreak prediction • Weather patterns

Abiotic Sensors & Platforms Group

- We need to match the frequency of actionable decisions with the frequency of measurements from a sensor suite. However, the frequency of intervention should not be considered to be a solved problem, and may merit re-investigation as part of this system.
- The farm is very permissive from a system packaging perspective – a sensing package the size of a seed is reasonable, as is something the size of a brick. Power considerations at these scale become very tractable.
- The determination of proximal, in-plant, or remote sensing is not yet understood, and it is unclear what form factor of sensors and host platforms is necessary. It is suspected that a combination is necessary, with tipping and cueing from coarser systems such as satellite data.

Biotic Sensors & Platforms Group

- Multi-modal sensor networks, possibly utilizing plant biosensors, UAVs, stationary wireless sensors, etc., could be more powerful and able to better measure directly key phenotypes than single types of sensors.
- Most sensor networks will have to be customized for specific crops and traits of interest, though crop modeling may allow them to provide general insight across similar plants.
- Researchers should identify surrogate measurements for a phenotype that are easy to quantify in the field.
- Utilizing the plant itself as a sensor is a promising approach, such as genetically engineering the plant with a reporter to a specific stressor to act as a sentinel, that could then be read out using a simpler sensor.
- “A bad sensor nearby is always better than a good one far away.”

Decision Support Group

- Data collection according to ontologies to ease integration
- High quality management data is not available, most other variables like plant growth, weather, harvest, can be obtained
- It would be valuable to develop methods for data masking / anonymization of agricultural data
- The highest demand decision is crop and varietal selection
- Need seasonal forecasts to make this decision

- Recommendation : build an open-source, freely available gold standard dataset

- “Most people treat machine learning like a toaster”

Breakout Session 2

What does an in-field sensor network look like?

Format:

- Smaller groups to design straw model system (30 min)
- Subgroup readout (30 min)
- Discussion; optional prompts for data impacts (30 min)

System Design Criteria:

- Covering a minimum of 200 hectares
- 10+ parameters
- Thousands of individual nodes – 1-10 m resolution contingent upon phenotyping need
- Minimum lifetime: 1 year
- Prescriptive or predictive output
- Maximum downtime 10% - node failure cannot result in system failure
- Must have an actionable output (e.g. prediction, prescription) or actuation (e.g. irrigation)