Precision Soil Management

Precision agriculture is a holistic and environmentally friendly strategy in which farmers can adjust inputs and cultivation methods – including application of seeds, fertilizers, pesticides, and water, variety selection, planting, tillage, harvesting – to match varying soil and crop conditions across a field (Srinivasan, 2006). Simply stated, precision agriculture controls input of what is needed, where it is needed, and when it is needed through the integration of information, technology, and management. A significant component of precision agriculture is precision soil management. In recent years precision soil management has become associated with the application of GPS (global positioning system) coupled field data (e.g. crop yield and soil fertility). These data are frequently collected once or twice a year with expensive, tractor-mounted sensors (Figure 1) and are used to determine spatial and temporal variation across a field. Once created, these spatial and temporal maps allow for the variable rate application of chemical fertilizers and pesticides. This approach to precision soil management relies heavily on chemical fertilizer inputs to increase (or simply maintain) the fertility of top soil.

An Introduction to LEARN

The LEARN (Low-input Education and Research Node) precision soil management system has be developed as an alternative approach to currently available soil management tools. The LEARN system utilizes multiple inexpensive soil sensor nodes (motes) positioned throughout a field to provide real-time soil parameter data. Sensor nodes provide data related to soil respiration (e.g. soil oxygen and carbon dioxide levels), moisture, temperature, and acidity. These soil data can be collected and stored locally (e.g. data logger) or transmitted in real-time via wired (e.g. serial) or wireless (e.g. Bluetooth) communication to a computer, or a portable handheld device (e.g. iPhone) (Figure 4). These data couple with a subsurface irrigation system (Figure 2) allow managers to actively manipulate microbial communities in soil, and/or plant growth media, that affect soil health and structure through the real time delivery of inputs such as water, gas (air, hydrogen, or other gases/gas mixtures), soluble fertilizers (organic and/or inorganic) and plant protection chemicals, as required.

References

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Figure 1 Veris (a) VISNIR and (b) pH sensor.
Figure 2 LEARN system schematic.
Figure 3 LEARN sensors and data.
Figure 4 LEARN communications.