Variable Rate Irrigation

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Systems are available to producers to make variable-rate applications of defoliants, fertilizer, lime, pesticides, plant growth regulators, and seed. These systems could potentially offer cost savings to a producer; however, the full potential of the benefits and savings cannot be realized if water is not managed properly. Variable rate irrigation (VRI, also called site specific or precision irrigation) allows a producer to apply different rates of water to different segments of a field. The need for VRI is similar to the reasons for other variable-rate applications. Highly variable soils within a field (clay in lower areas with sandy loam ridges), topographic variability (high ridges, settling in filled areas after grading, or drainage ditches in a field), and multiple crops and/or planting dates are a few of the situations that would be helped by VRI. While surface irrigation systems aren't well suited for variable rate water application, center pivot systems can be equipped for it.

All center pivot systems currently available from the manufacturers can apply different rates of water during irrigation by varying speed. However, most systems cannot change the application rate along the length of the pivot. The whole system can speed up to apply less water or slow down to apply more. However, if a pivot is simultaneously crossing areas that are wet (drainage area) and dry (sandy), then a traditional system would have to address one problem and over- or under-irrigate the other area. Conversely, a VRI pivot could apply less water to the wet area and more to the dry area at the same time.

The two Valley[1] center pivots at the Marsh Farm are true VRI systems. The east pivot was converted to variable rate in 2010 and the west in 2011 for use in the university and ARS irrigation research programs. Figure 1 shows the fields and the different soil types. Like most Mid-South fields, the combination of wind, water, and seismic activity over the years has resulted in tremendous soil variability. Areas such as sand blows and fissures resulting from the New Madrid earthquakes of 1811-1812 are usually too small to be included in soil maps, but can greatly impact irrigation management. Despite land grading efforts by farmers, these features still persist in fields and affect the infiltration and water holding properties of soils. Therefore, they must be considered in irrigation management and since they usually make up a small portion of the total field they can be addressed quite well with VRI.

Like many variable rate systems, VRI is currently prescription based. In other words, all available information is used to develop a map of the different application amounts needed in the field; then the information, or prescription, is uploaded into the VRI controller. Figure 2 shows a VRI prescription used in 2010 for rice produced near Dysersburg, Tennessee. The controller will cause sprinklers in areas receiving less than 100% of the target application to pulse on and off to attain the desired amount.

[1]Mention of trade names or commercial products is solely for purpose of providing specific information and does not imply recommendation or endorsement by the U.S. Department of Agriculture.

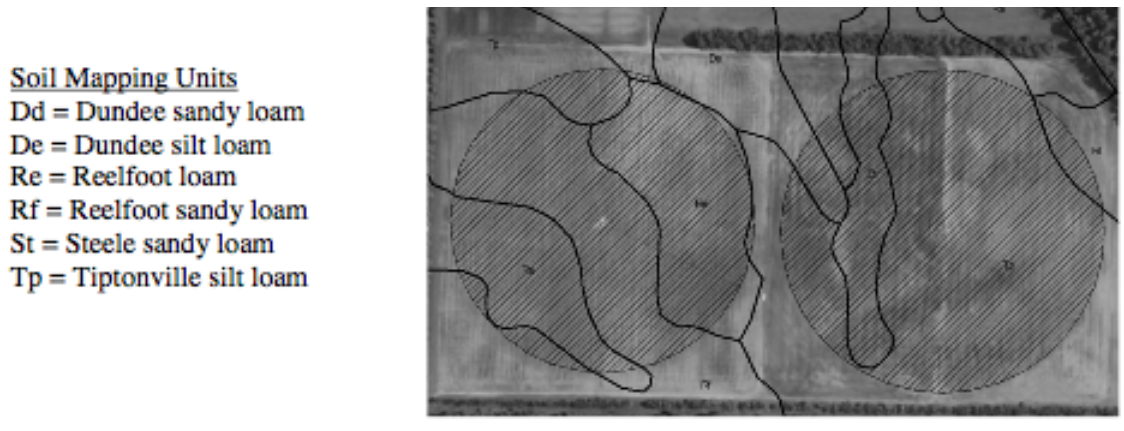

Figure 1. Variable rate center pivot systems at the University of Missouri Delta Research Center Marsh Farm showing soil mapping units in the fields.

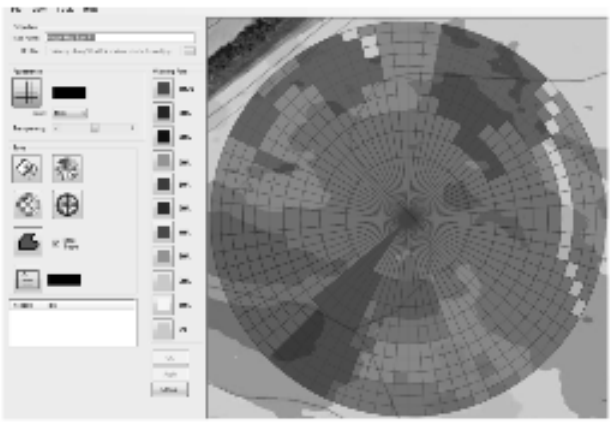

Figure 2. VRI prescription for center pivot system near Dyersburg, Tennessee, in 2010. The underlying image of soil apparent electrical conductivity and mapping units were two of the factors considered in developing the prescription.

In late 2010, researchers from several ARS locations, including Portageville and Columbia, decided to coordinate their VRI research efforts. The resulting Multi-Location Research Project, "Site-Specific Irrigation Management and Water Use Efficiency Tools (SSIMWUET)" was created with the aim of: development of site-specific irrigation management hardware and software tools for automation of moving and stationary irrigation systems as a means to increase crop water productivity and producer profitability. In addition to the ARS scientists, many university and industry colleagues will participate in the research. While part of the project intends to provide guidance on preparation of VRI prescriptions, another goal is the ability to operate in real-time mode, where the application can change with each irrigation in response to sensors measuring soil and/or plant conditions, allowing the most efficient water use possible. Δ

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