VARIABLE RATE IRRIGATION FOR VEGETABLE PRODUCTION

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Water is an invaluable resource for the Wisconsin vegetable industry. In recent years, agricultural irrigation has been linked to reduced ground and surface water levels in the Central Sands region, where the majority of the Wisconsin vegetable production is located. Therefore, new technologies and strategies that can improve the irrigation efficiency of vegetable cropping systems have become a top priority for the industry. About 99% of Wisconsin vegetable growers are using center pivot irrigation systems, and Variable Rate Irrigation (VRI) has been adopted by some pioneers in recent years.

The VRI technology applies water at variable rates rather than one uniform rate along the length of the center pivot. There are two steps to apply VRI: firstly, based on electrical conductivity (EC) or elevation mapping, the field is divided into different management zones; secondly, the system applies specific amount of water on different management zones by controlling the moving speed of the pivot or turning on and off individual nozzles. VRI can apply water at differing rates to different crops or cultivars, varying soil types, high runoff areas or low areas prone to getting wet and saturated, and environmentally sensitive areas within the field. The overarching goal of VRI is to avoid over- and under-irrigation so no water is wasted and no water stress occurs, while crop yield and quality are maintained or increased. Currently the main hurdle of wide adoption of VRI is the upfront cost, ranging between $5,000 and $50,000 per pivot, and the potential of VRI to improve farm water conservation as well as profitability.

In 2018, our group evaluated production of potatoes or green beans under VRI on three commercial fields. Each field had 10 to 20 feet elevation difference between the highest (driest) and lowest (wettest) areas. Field 1 grew potatoes and had nozzle control VRI; field 2 also grew potatoes and had speed control VRI; field 3 grew green beans, had nozzle control VRI but was irrigated with flat rate of water all through the season. Our data showed that:

- On field 1: About 0.2 million gallons of water per acre was saved by VRI, and there was a significant improvement of potato yield and quality in the driest area/average area compared to the wettest area;

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- On field 2: About 0.15 million gallons of water per acre was saved by VRI. There was no significant difference of potato yield over the field, but those in the driest area and the average area showed better quality than those from the wettest area;

- On field 3: No green bean yield difference was observed between the average area and the wettest area. Yield in the driest area was 27% lower ($p<0.05$) than yield in the average area, and 28% lower ($p<0.05$) than the wettest area.

So far our data have suggested that:

- A big benefit of using VRI is to improve vegetable crop yield, quality, therefore to improve the profitability in the high runoff (or the driest) area of a field, which is more vulnerable to under-irrigation;

- VRI can save irrigation water in the low area of a field that tends to be wet or saturated. However even under VRI, managing yield and quality in the low area is still challenging, since crops tend to have more rotting and defect issues.