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GETTING MORE OUT OF 4R PERFORMANCE INDICATORS WITH PRECISION AGRICULTURE

One of the unique components of 4R Nutrient Stewardship that separates it from traditional nutrient management planning strategies is the inclusion of performance indicators. Performance indicators are parameters that can be used to objectively evaluate outcomes from a specific set of management practices selected for a specific cropping system. The performance indicators are chosen based on stakeholder input and will align with the sustainability goals for the crop production system. Precision agriculture (PA) technologies can improve the quality of information that performance indicators provide and subsequently increase the ability to properly evaluate chosen practices.

Yield mapping can greatly enhance the information gained from one of the most easily measured performance indicators. Yield is often used as an indicator of economic sustainability and to assess both productivity and profitability of chosen practices. However, spatial variability in yield is masked when considering the average yield for the entire field. While performance indicators are selected to evaluate fertilizer practices, it is important to note that they are also affected by several non-fertilizer factors. Locating and quantifying yield variability through mapping can help identify these factors (i.e., compaction, poor drainage, soil textural changes, etc), which might need to be managed differently leading to even greater sustainability.

Yield data can also be used to calculate nutrient balance by multiplying yield by a scientifically validated nutrient removal coefficient. Nutrient balance is a performance indicator that typically provides an accounting of total nutrient inputs and outputs. Calculating nutrient balance on a spatial scale can help evaluate the effectiveness of variable-rate (VR) fertilizer applications. It can also identify fields receiving uniform fertilizer rates that may respond favorably to VR applications. Nutrient balance also provides an indirect measure of nutrient surpluses, which can affect the environmental sustainability of the cropping system.

Nutrient use efficiency (NUE) is another performance indicator often tied to environmental and economic sustainability. Nutrient use efficiency is often mistaken as the most important indicator of sustainable fertilizer practices. However, nutrients are applied to improve the overall performance of the cropping system and NUE is only one aspect of that performance and can be defined many different ways. Various PA practices have been shown to improve NUE including VR nitrogen (N) fertilizer applications based on crop reflectance. Research conducted by Dr. Wade Thomason at Virginia Tech demonstrated that using GreenSeeker[®] crop sensors to determine in-season N rates for wheat and corn increased NUE (calculated as recovery efficiency) by 7% and 13%, respectively.

Automated equipment technologies also contribute to the value of performance indicators. Technologies like auto-guidance, section control, and variable-rate distribution significantly improve the precision of agricultural inputs. The ability to eliminate overlapped applications has economic implications as demonstrated by survey data collected by the Auburn University Precision Ag Extension Team, which show an average of 22% saving on input costs when utilizing the above-mentioned technologies. There are also environmental and social benefits to the ecosystem due to the precise application of inputs near conservation structures (i.e., grass waterways) and outdoor recreation areas.

Finally, on-farm data collection leads to more comprehensive outcome evaluation and continuous improvement in nutrient stewardship. Another unique characteristic of 4R stewardship is the dynamic feedback mechanism that is central to the evaluation process. There are cycles of action and evaluation at each level of the stakeholder group (farm, regional, and policy). The opportunity to use PA technologies to collect high-resolution, geo-referenced data (tabular and graphic) on nutrient prescriptions, applications, and removal greatly enhances the evaluation process, results in increased transparency and accountability of practices among stakeholder groups, which in turn lead to the adaptive management necessary to meet sustainability performance goals.

To learn more about these and other PA technologies, consider attending the next InfoAg Conference, which will be held August 2 – August 4, 2016 at the Union Station Hilton in downtown St. Louis, MO. In 2016, InfoAg and the International Conference on Precision Agriculture will be co-located, providing additional educational and networking opportunities. Stay informed by visiting www.infoag.org and following @InfoAg.

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