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## THE ROLE OF SPATIAL VARIABILITY IN NUTRIENT MANAGEMENT

**A thorough understanding of spatial variability in agricultural fields can influence many aspects of nutrient management.** Whether it is what nutrient source to apply, what rate to use, when to make the fertilizer application, or what placement method to employ, understanding spatial variability can help growers, advisers, industry, and policymakers contribute to more efficient and effective fertilizer management.

**Understanding spatial variability can help guide technology development.** Yield monitors, mapping software, and variable-rate fertilizer applicators were all developed based on the knowledge that not all areas of a field possess the same yield potential and often don't have the same nutrient requirement. Precision agriculture technology currently provides growers and advisers the tools needed to identify, diagnose, and treat spatial variability in fields. However, continued investigation into the effects of variability on fertilizer management will improve our understanding of the situation and will lead to refined approaches and the development of new technologies needed to meet the challenges.

**By applying fertilizer only where it is needed in the field, productivity and profitability can be improved.** Most standard nutrient recommendation strategies involve determining an average fertilizer need for the field and a single rate is applied to the entire field. Using this strategy, some areas of the field receive more than the optimum amount of fertilizer while other areas may not be receiving enough. Applying fertilizer in this manner results in lower productivity and profitability due to missing out on additional yield in the parts of the field that are under-fertilized and further reduced profitability where fertilizer is over-applied. Understanding how fertilizer requirement varies spatially in a field will allow the grower to use variable-rate application technology to redistribute fertilizer accordingly throughout the field.

**Considering spatial variability when making fertilizer management decisions can also improve environmental quality and cropping system sustainability.** Using spatial information to better match crop requirement with nutrient supply will result in less fertilizer remaining in the field with the potential to negatively impact the environment through various loss mechanisms. Understanding the sources and influence of spatial variables such as soil type, water and nutrient holding capacity, slope, topsoil thickness, etc., can aid growers and advisers in selecting appropriate BMPs for each field that will support the long-term health of the cropping system.

**Understanding spatial variability is critical when following 4R Nutrient Stewardship.** 4R nutrient stewardship is selecting the "right" fertilizer source and applying it at the right rate, at the right time in the growing season, and in the right place. What is "right", however, depends on many site-specific factors, including the degree of spatial variability a particular grower might be dealing with. Failing to consider spatial variability when making nutrient management decisions can result in what appears to be the "right" choice for the field being quite "wrong" in many areas of that field.

**Following 4R nutrient stewardship at the appropriate spatial scale can lead to improved fertilizer efficiency and effectiveness, increased productivity and profitability, and lower risk of environmental impacts due to misapplication of fertilizer.**

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Abbreviation: BMPs = best management practices.