IPNI
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Better Crops, Better Environment...through Science

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CONNECTING FERTILIZER MANAGEMENT TO SCIENCE

Crop advisers promote best management practices for fertilizer use. Everyone supports the concept of applying the right source at the right rate, time and place, but determining what is "right" is not a simple matter. Society has high expectations for progress on environmental sustainability issues associated with producing sufficient safe nutritious food. A framework to connect fertilizer management to science is essential to such progress.

Best management practices contribute to four objectives. To evaluate what is "best" or "right," each practice's influence on productivity, profitability, sustainability, and environmental health needs science-based assessment. Progress toward these four interconnected objectives benefits both producers and the public. Let's look at what each entails.

1. **Productivity.** It means more than crop yield per acre. Total factor productivity includes yield per unit of labor, water, nutrient, energy, and machinery inputs as well. The level of each input influences the productivity or efficiency of the others.
2. **Profitability.** No cropping system can keep going without it. Profitability is one measure of the value of a system's output to society. Both producers and their local economy depend on crops producing profits.
3. **Sustainability.** Essentially, productivity in the long-term. It's been defined as a cropping system in which output does not decrease when inputs are not increased. Today's real-world situation demands continuously increasing outputs—and inputs. Soil quality, in terms of both fertility and physical structure, is key to sustainability.
4. **Environmental health.** It's the total impact of the cropping system on the surrounding ecosystem. Both producers and the public value ecosystem services such as clean water, clean air, and natural biodiversity.

How do we ensure that fertilizer management contributes to all four objectives? We need multiple indicators of performance. For example, recent research in Ontario, Canada showed that tomatoes grown with fertigation management had higher optimum N rates. This finding was counter to expectations, since the higher N use efficiency (a single indicator) associated with fertigation was assumed to justify lower rates. The assessment of a higher optimum being "right" depended on a more complete set of measured indicators including higher yields and quality, and acceptable values for crop N recovery and residual soil nitrate.

So what's the role of science? When best management practices are evaluated, good science relates their impact to all four objectives. Such science includes general principles relating to the comprehensive measurement of system output changes, and specific principles relating to the disciplines of crop and soil sciences. These principles determine a balanced set of indicators reflecting progress toward the four objectives.

The science is not complete. The evaluation of some practices has gone no further than yield and profit. Others have been assessed for only a single specific impact on the environment. Continuing research—on-farm, at the experiment station, and in the laboratory—needs to define and document the right source, rate, timing and placement for fertilizer use in each cropping system. Increased public and private investment into such research is key to meeting society's high expectations.

Further information on a global framework connecting fertilizer management to science is available at the IPNI website: >**www.ipni.net/conceptpapers**<.

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Abbreviations in this article: N = nitrogen.