Phases in Narrowing the Yield Gap

By Paul E. Fixen

Growers who achieve record-setting yields challenge research scientists and farmers to study how those successes can be replicated in other locations and cropping systems. Observing the practices of high yield growers through the lens of scientific principles can be revealing and lead to researchable questions. Modern technologies can facilitate the process of answering these questions. But major yield improvement requires a willingness to risk changing the way things have always been done.

As we observe how research scientists and farmers often approach this challenge, recognition of phases in yield improvement might be helpful. **Table 1** presents four possible phases and the likely yield benefit and risk level of each.

The first phase is to fully implement standard agronomic best management practices (BMPs) on a site-specific basis. These are well proven practices and so minimal agronomic and economic risk is involved. However, since individuals serious about the challenge at hand are likely to be using BMPs already, yield gains from this phase are likely to be minor.

The second phase is to experiment with optimization of sets of easily controlled production factors. Because the level of one factor can influence response to others, multiple factors must be varied simultaneously. Because of the more complicated nature of such evaluations and uncertainty, more risk is involved, but yield gains may be greater as well.

Table 1. Yield benefit and risk associated with yield improvement phases.

Phase	Yield benefit and risk
Fully implement standard agronomic **site-specific BMPs**	Lower
Experiment with optimizing **sets** of easily controlled factors with the potential to increase yields	
Experiment with **system-level** changes, then re-optimize factors	
Long-term soil quality improvement with continuous re-optimization of factors as soil properties change	Higher

Phase three involves evaluation of system-level changes like tillage, row-spacing, crop rotation, etc. These are harder still to evaluate so risk is higher, but we take another step up in the potential for yield payback. A change in the system may require re-optimization of the factor levels focused on in phase two.

The final phase has the largest potential impact on yield because crops benefit from the accumulating beneficial effects of past high yields: greater carbon fixation and, as a result, higher soil organic matter levels and improved tilth and water holding capacity. Improved subsoil properties and an associated improved root system may also result. Risk is also high because we do not know if the system being implemented will cause these positive long-term trends until it is in place for several years. As soil properties change, production factors will likely need to be re-optimized.

Thinking in terms of yield improvement phases makes it apparent that a portion of a farm's yield gap can likely be closed in just a few years. A larger portion is likely to require long-term dedication …and patience. BC

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