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The Law of the Minimum

If you have ever taken courses in soil science, agronomy, or general agriculture it's very likely that you have been introduced to Justus von Liebig (pronounced “Lee-big”). His “Law of the Minimum” describes the intuitive finding that plants, animals, and even population growth, is limited by the availability of the scarcest resource.

As a paradoxical side note, Liebig did not actually discover this finding, but rather just explained it so much that he’s credited with it.

Yet to ensure understanding of this fundamental rule, Crop Science 101 professors often supply the “barrel-staves” example: Visualize a wooden barrel whose staves (the wooden slats that make up the barrel’s sides) are each a different height. If you tried to fill this ridiculously constructed barrel with water, the meandering fluid would rush out just above the top of the shortest stave. The barrel’s capacity is limited by the height of the lowest stave, irrespective of how high all the other staves extend.

On these diagrams, professors often write, “N”, “P”, “K”, “Ca”, and other elemental symbols on the barrel’s staves to represent plant macro- and micronutrients, while the water in the barrel represents a crop’s total yield.

Frankly speaking, this makes perfect sense and is so intuitive that it often begs the question, “Do we really need a scientific LAW to describe such an easily observable condition?”.

Consider how often we fail to recognize the missing component.

In crop production, farmers and agronomists work tirelessly to optimize fertilizer applications that address both productivity as well as economic constraints using this law of the minimum framework. We use soil tests, plant tissue analyses, and even advanced multi-spectral imagery to guide and verify our fertilizer decisions. In many instances, we get it right by addressing the yield-limiting nutrient with a perfect dosage.

In many other cases, we not only get it wrong by over or under applying fertilizer, we may not even be addressing the specific yield limiting factor.

Psychologists may call this phenomenon, “availability bias”, a systematic error in judgment arising from incomplete information. We overemphasize the information that we already have in front of us without seeking additional information that could reveal an alternative condition when we make a decision.

This is to say, the analogue crop may not actually need any more fertilizer of any kind.

Since Liebig's Law of the Minimum – like all other aspects of decision making – is subject to availability bias, it's crucial that we seek all available information to make an informed decision. Take for example soil testing; in previous articles we've addressed the important contribution that soil biology plays in agricultural systems. Yet our traditional soil testing methods do not include metrics that evaluate soil biology. Seeking an additional soil test that does quantify biological contribution may be valuable in minimizing the potential for making a poor decision based on limited information.

Though certainly in our data-driven world, "analysis-paralysis" – the condition when there's an overload of information that inhibits even making a decision – looms large the more we add new information.

As we make our crop plans this winter, if you would like to gain more insight into making data-driven decisions that minimize the risk of cognitive biases and support Liebig's Law in your crop production, please consider attending upcoming University of Maryland Extension events at which you will learn more about crop production and data management that improve your business's profitability.

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