eKonomics

Allocating Your Fertilizer Dollar,
Where Should You Invest?

PotashCorp

agriviews

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Allocating Your Fertilizer Dollar, Where Should You Invest?

This time of year there are typically several articles published in trade magazines and University bulletins discussing how farmers should make adjustments to input purchases (specifically fertilizer) to increase the profitability of their farming operations.

When budgets get tighter, one common recommendation is cutting back on potassium and phosphorus. This may be an option if you have an adequate supply of these nutrients in your soil. However, cutting back without evaluating soil test levels, and considering the agronomic and economic implications, is likely not a good decision.

The purpose of this article is to illustrate the importance of a good crop nutrition program, and why blindly cutting back on some fertilizer inputs could actually cost you money.

Liebig's Law of the Minimum

For those who have attended a soil fertility meeting or a crop nutrient management class, you have seen the barrel concept (Figure 1) used to illustrate Liebig's law of the minimum. Liebig's law states that the yield achievable is dictated by the nutrient that is most limiting. Stated using the barrel analogy, the amount of water a barrel will hold is a function of the length of the shortest stave.

Let's assume that potassium is the most limiting factor. If a field's yield potential is 220 bushels per acre (with adequate potassium nutrition), but soil test potassium level will only allow yield to reach 80 percent of the maximum, the actual yield achievable is 176 bushels per acre. This scenario assumes that all other nutrients are supplied at 100 percent sufficient levels (an assumption most forget to include when discussing the law of the minimum).

Remember, the goal of any agronomist is to proactively identify and remove yield-limiting factors. This concept applies to soil fertility, weed management, pathology, entomology and other agronomic considerations.

How does this apply to allocating your fertilizer dollar? Blindly cutting potassium or phosphorus and focusing the bulk of your fertilizer investment on nitrogen can be a yield-limiting, and profit-decreasing, decision. This is especially true if potassium or phosphorus have limited availability based upon soil test. The crop will respond to applying nitrogen fertilizer, but the yield achieved will be limited based on the extent of potassium and phosphorus inadequacy.

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Figure 1. Liebig's law of the minimum illustrated using the barrel stave concept.

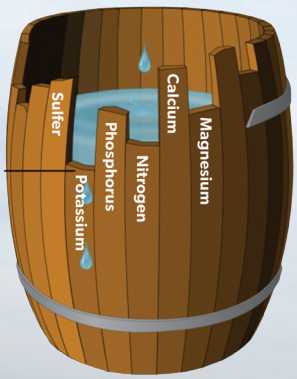


Figure 2. Corn response to nitrogen fertilization with and without phosphorus fertilization.

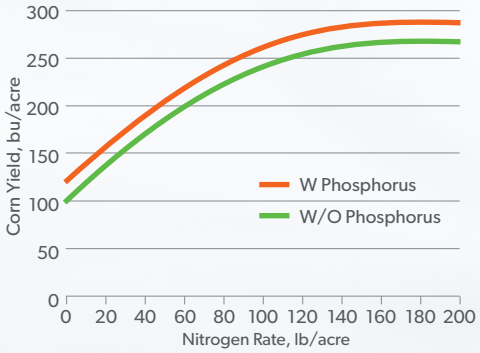
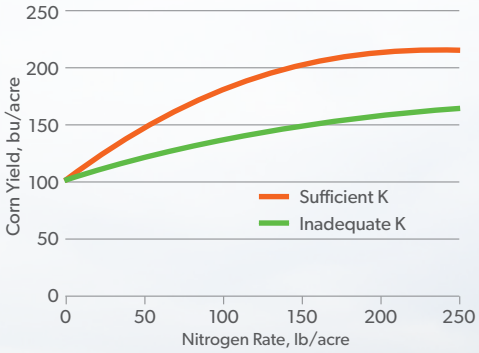


Figure 3. Corn response to nitrogen when inadequate potassium is supplied and when sufficient potassium is supplied.



Data from research conducted in Ohio (Better Crops, 1998).

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Figure 2 is a simple visualization of this concept. Notice the green line (representing corn yield with inadequate phosphorus) does increase as nitrogen application increases. However, also note that the red line (representing corn yield with adequate phosphorus) allows for a higher maximum achievable yield when nitrogen and phosphorus are supplied. In this example, the yield achievable with both adequate phosphorus and nitrogen is 20 bushels higher than with adequate nitrogen alone.

More Nutrient Interactions

Some nutrient inadequacies can actually affect the crop's ability to utilize other nutrients supplied. The most commonly mentioned nutrient interaction is nitrogen and potassium. The nature of the interaction is such that whenever potassium is inadequate, the crop can require more nitrogen to achieve the optimal nitrogen rate (the rate where yield is maximized) and typically at a lower yield level. A video discussing this interaction is available on our eKonomics website at potashcorp-ekonomics.com/latest-fertilizer-research/.

In Figure 3, the green line represents corn response to nitrogen whenever potassium is not adequately supplied. Note how corn yield never quite reaches a maximum, i.e., yield is still increasing in response to an increased supply of nitrogen. The red line represents a scenario where adequate potassium has been supplied. Notice how the corn crop achieves a higher yield, and reaches it at a lower nitrogen rate, compared to the inadequate potassium scenario.

Another benefit to maintaining adequate potassium availability in soil is the potential interaction with phosphorus. Unpublished field research conducted at Ohio State University from 1994-1999 revealed that in situations where soil test potassium was below the established critical level, corn and soybean yields could decrease by increasing the phosphorus fertilization rate. This yield decrease occurred three out of seven research years in corn, and three out of six research years in soybeans. The exact physiological mechanism that would cause crop yield to decrease as a result of increasing the phosphorus application rate in a soil environment with inadequate potassium is not well understood.

Research conducted on alfalfa reveals a similar interaction between phosphorus and potassium. This study was conducted over seven years at Purdue University (Berg et al., 2005). During the final two years of the study, it was noted that plots receiving no potassium fertilization experienced decreased alfalfa yield by increasing the phosphorus fertilization rate. Therefore, forgoing potassium fertilization not only limits production, but supplying additional phosphorus combined with poor potassium fertility can actually decrease productivity.

Data such as this points to the importance of identifying and removing each yield-limiting factor because nutrient interactions can and do occur.

Table 1. Economic impact of potassium fertilizer decisions for a corn crop based on yield potential, soil test level and commodity price.

Yield potential, bu/acre	Soil test level, ppm	Crop price, $ per bushel	Average return generated, $ per acre
180	75-100	3.00	23
		3.50	34
		4.00	45
	100-130	3.00	-2
		3.50	1
		4.00	5
220	75-100	3.00	38
		3.50	51
		4.00	64
	100-130	3.00	3
		3.50	7
		4.00	11

*Assumptions used in the Nutrient ROI calculator – State/Region – Midwest Hybrid, Nutrient analysis – 0-0-60, Potash retail price $500/ton, Desired fertilizer rate – University recommended rate.

Making the Agronomic… Economic

These agronomic concepts and realities obviously have an economic impact on the farming operation. Opting to skip fertilization of potassium or phosphorus (or really any limiting nutrient) in an effort to save money can actually decrease total economic profit.

On our eKonomics website (potashcorp-ekonomics.com) we have an ROI (return on investment) tool that can help you understand just how much average return is generated from your fertilizer investment.

Table 1 illustrates how yield potential, soil test level and commodity pricing influence the average economic return from potassium fertilization. Cutting potassium fertilization when soil test is below 100 ppm (parts per million) represents considerable lost economic return especially as commodity price increases. The economic penalty for cutting potassium fertilization decreases as soil test level climbs above 100 ppm, but as the commodity price increases the return-not-realized if fertilization is skipped also increases.

Make certain you know just how much yield – and economic return – you are leaving out in the field before making a decision for any crop.

References

Berg, W.K, S.M. Cunningham, S.M. Brouder, B.C. Joern, K.D. Johnson, J. Santini, and J.J. Volenec. 2005. Influence of phosphorus and potassium on alfalfa yield and yield components. Crop Science Society of America Journal 45:297-304.

Potassium interactions with other nutrients. 1998. Better Crops 82:12-13.

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