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2-1988

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### Repository Citation

Murdock, Lloyd W.; Wells, Kenneth L.; and Thom, William O., "Maximum Net Returns from Fertilizers" (1988). *Soil Science News and Views*. 71.

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Department of Agronomy

# Soil Science News & Views



Vol. 9., No. 2, February 1988

## MAXIMUM NET RETURNS FROM FERTILIZERS

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Considerable interest in trends taking place in the consumption of commercial fertilizers in Kentucky has been evident during the last two or three years. Due both to the stressed agricultural economy and to government programs, total tonnage has dropped significantly. This has made a direct impact on the fertilizer industry serving Kentucky. Concern has been expressed that UK is "telling farmers that they're using too much fertilizer", suggesting that this is the cause of the reduced volume experienced by many dealers. We hope to address this concern in such a way that UK's position regarding use of commercial fertilizers for crop production can be better understood.

First and foremost, UK recommendations are based on the best research available in Kentucky relating the response of crops to use of fertilizers as influenced by the soil test levels before applying fertilizer for the crop to be grown. Secondly, the basic philosophy behind UK fertilizer recommendations is to use the rate necessary to produce a good crop for the year in question. This is commonly called the "crop sufficiency" philosophy. We do not include fertilizer for build-up of soil test levels or for replacement of fertilizer removed by the crop. There has been no change in this philosophy from that of past years. The only thing that changes the rates UK recommends is the results of new research which may suggest either increased or decreased rates relative to the "sufficiency" philosophy. In short, if a soil test calls for fertilizer by our standards, we recommend it. If soil tests are high enough that a crop response to fertilizer is unlikely, we don't recommend fertilizer. In this regard, analysis of the 50-60 thousand soil samples tested in UK's labs each year shows convincingly that the percentage of fields testing high enough so that UK doesn't recommend

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fertilizer has steadily increased over the past several years. Because of this, it is quite likely on the average that the total amount of fertilizer UK recommends per average acre of crop grown each year has decreased. On this basis, the following discussion is presented about how we feel the use of fertilizer relates to farm production economics.

In order to look at this situation, consider the basic equation; "Net Returns equals Gross Value of Production minus Total Costs of Production". Abbreviated, this says that Net Returns = Gross Returns less Costs, which is both accurate and simple. With a goal of maintaining or hopefully increasing net returns, there is more than one way in which returns and costs can interrelate. For example, net returns can be increased in the following ways:

- increased returns and stable costs
- stable returns with lowered costs
- increased returns and costs, but with returns increasing at a faster rate than costs.
- decreased returns and costs, but with costs decreasing at a faster rate than returns.

In looking at crop production and net returns and costs, several other things must be considered.

#### Factors Affecting Gross Returns

Two basic factors are involved here. . . production (yield/A) and market receipts per unit of production. Since producers for the most part are at the mercy of the market with regard to the value per unit of production, the dominant methods which have been advocated in the past to increase gross returns are to either: (1) increase yields per acre; (2) to grow more acres; or (3) to do both. These commonly used methods of increasing gross returns nearly always have meant higher production costs.

As a buffer against the normally occurring low market prices during and immediately following the harvest season, many producers have done such things as forward contract, play the futures, store, participate in various government programs, and market crops through livestock in order to maintain or increase gross returns. Most growers have also been shooting for the highest possible crop yields per acre and have greatly expanded their total acreage. These basic strategies worked fairly well until the bottom dropped out of prices received without drops of corresponding magnitude in total production costs, including mortgages and other borrowed money.

#### Factors Affecting Total Production Costs

Economists usually classify costs into two categories. . . fixed costs and variable costs. Fixed costs are cost of those

items necessary to just be in the farming business, such as land, buildings and facilities, machinery, taxes, etc. In most cases these are referred to as "overhead". Variable costs, sometimes called "out-of-pocket costs", are those costs necessary to put out a crop, harvest, and market it. It's within the realm of the variable costs for crop production that the fertilizer and ag chemical industry must exist. While a producer's options are limited for reducing short term fixed costs after he has committed to farming, he can manipulate variable costs in hopes of lowering total costs of production on an annual basis. Fertilizer, lime, and ag chemicals are the big-tag items that can represent up to 40-50% of total variable costs. The big question a producer must ask each year is "what kinds and amounts of fertilizers, lime, and ag chemicals do I need for each field, and if I need them, how much do I need?"

#### Relating Maximum Net Return Agriculture to the Equation

In relating the "maximum net return" agriculture concept to the equation of "Net = Returns less Costs," we need to develop some common ground about what the term "maximum net return" means. We define the term as meaning that no variable expense will be made on a crop unless it can economically be justified. First, let's justify lime and fertilizer expenses. If the soil is really acid . . . say 5.5 or less, a producer really can't do without some lime, particularly if growing legumes. But he may not need the full dose just for this year. Instead of applying the rate which would raise pH to 6.5 to 7.0, he could consider applying the rate for pH 6.0 to 6.5. Yields, except for forage legumes, are not likely to be affected very greatly and even if they might, molybdenum could be used. It may be cheaper than a couple of tons of lime. For corn or sorghum, adequate yields can be produced with soil pH's of 5.5 to 6.0 for one year. However, in the long run a pH above 6.0 is definitely more desirable. When liming, be sure that the lime is of good quality. Don't waste money on a poor quality product. Also, care must be taken to match herbicides against soil pH, or there could be residual problems with many weed chemicals. And, don't forget that the acidity problem will not be solved for the 3-5 years effective time period ordinarily attained with a normal liming rate. Scaling back on rate is only a means of cutting costs on a year-to-year basis.

What about fertilizers? Since N is the most expensive, let's consider it first. From the maximum net return angle, producers are trying to balance the need for fertilizer N without sacrificing yields. The first thing to consider here is what the residual soil level of N might be. In Kentucky, estimates of residual N are based largely on the field's previous cropping history, particularly last year's crop. An estimate of residual N is taken into account in UK recommendations for nitrogen. When dealing with a livestock farm, manure can be used to reduce the amount of fertilizer N needed. The most important point here is that N has a very great effect on yield of N-requiring crops and

all sources must be considered. After adjusting the fertilizer N rate, the fertilizer must be applied in such a way as to lower risks for losses due to leaching, denitrification, volatilization and immobilization. Just be sure that all application techniques for the particular soil-plant-climatic situation in question are used. Splitting or delaying the nitrogen application for corn on soils that are less than well drained allows N rates to be reduced 25-50 lbs/ac from that recommended when all the N is applied at planting.

Some may question that this is "maximum net return" technology, particularly when compared to rates sometimes recommended based on an amount of fertilizer N required per bushel of production and some yield goal. Research in Kentucky indicates that yields of corn seldom increase for rates of fertilizer N above 150 lbs/A except on wetter type soils. Yield goals are difficult to set due to varying climatic and soil conditions. Past yield history is probably the best guide to follow in predicting what yields may be obtained, unless working in a situation where past management has been poor and resulted in low yields.

What about use of P and K as they relate to maximum net return practices? During the last 30 years, the use of commercial fertilizer in Kentucky has resulted in increases in the soil test levels of phosphorus and potassium. Of the samples sent to the University of Kentucky in 1985 (the last year of available records); 3/4 of the samples to be planted to corn, soybeans, or alfalfa and over 90 percent for tobacco tested medium or high in phosphorus and potassium. There is a wealth of research data to substantiate that there is a very low likelihood of getting a yield response to fertilizer P or K if soil test levels are above the middle part of the medium range. For the widely used Bray's P-1 phosphorus test, this means soil test levels above 45 lbs/A. For the widely used ammonium acetate extractable K, this means soil test levels above 210 lbs/A. The only exceptions seem to be short season, fast growing crops, and situations involving cool soils or compacted soils. Despite the philosophies of "build-up", "replacement", or "maintenance" often used to justify application of fertilizer P and K, it's very unlikely that yields of common agronomic crops will increase if more P or K fertilizer is applied to soils when they are above these soil test levels.

One of the greatest controversies is the basis on which labs make recommendations. Long-term field studies have been conducted by the University of Nebraska, the University of Kentucky and others to illustrate this point. For the past several years, experimental sites at several locations have been sampled, then split and sent for analysis and recommendations to commercial labs serving the respective states. In Kentucky the recommendations were modified by the local dealers. Samples were also sent to the University labs. The recommended kinds and amounts of fertilizers were then applied in the field and crop

yields were measured. Sizeable differences have been recommended both in kinds and rates of fertilizers necessary. These differences are almost always related to differences in philosophy used in making recommendations. On the one extreme is the "crop sufficiency" approach where only that necessary for next year's crop is recommended, based on the soil test levels measured. This results in the fewest kinds and least amount of fertilizer recommended. Other philosophies increase the kinds and amounts of fertilizers to "replace" what the crop removes and/or to "build" soil tests to high levels. The field trials conducted in the different states have very convincingly shown two notable things: 1) Yields are about the same regardless of the recommendation tested, and 2) cost for the higher recommendations tested was about twice that of the lowest cost one. . .the one made on a "crop sufficiency" basis. Why would it be in the best economic interest of any farmer to spend up to twice as much for fertilizer than was necessary to get top yield? Secondly, why would farmers continue to do business with a farm supplier that was recommending higher fertilizer rates which were not increasing his crop yields?

It is important that soil testing laboratories use extractants and procedures which have been shown experimentally to be valid for soils in the area they serve, and that the soil test results have been correlated experimentally to crop yield responses in years of field trials. Agricultural experiment stations in the various ag colleges have conducted the basic experimental work to develop appropriate soil test procedures over the years, and continue to do so. They also have conducted the field correlation and calibration studies which are vital to the proper interpretation of soil test results. This is the best source of information against which to compare recommendations from any laboratory.

What all this means in terms of "maximum net return" agriculture is that one can often lower fertilizer costs for P and K substantially without affecting yields on soils testing above the middle of the medium range. High soil test levels of P and K are not needed in order to get high yields. However, if these suggestions are followed, fields should be tested each year or two, because there isn't as large a buffer against running short of P and K as there would be if test levels were higher. But the point is, variable costs can often be substantially cut without much likelihood that crop yields will suffer during the upcoming season due to less than optimal levels of P and K in the soil.

If P and K are needed, rates often can be reduced by band applications without limiting yields. Banding can improve phosphorus and potassium efficiency over broadcast applications allowing broadcast rates to be reduced by 30 to 50%. But this needs to be analyzed in order to determine if the fertilizer savings due to banding can justify the equipment, time, and labor required as compared to a broadcast application at a higher rate.

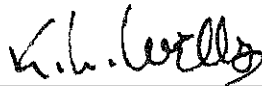
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Efficient use of all the crop inputs is important in order to obtain maximum returns. In order to do this, good solid data is necessary. No one has all the answers, but any recommendation should be based on consistent trials that establish a need and rate for a nutrient over a period of years under conditions similar to the area in production. Each producer and field will be site-specific as to what combination of variable cost items and reasonably expected yield levels can be put together to hold or improve net returns. It seems that under the current agricultural situation, producers would find it in their best interest to spend their money only on items which will result in the greatest dollar returns per dollar invested.

  
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