

### Optimum P and K Improves Profitability and the Farmer's Capacity for Environmental Stewardship

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**D**OCUMENTED in the historical records of agriculture is the sobering fact that environmental protection declines with the progressive deterioration in farm productivity and profitability. In the South, cotton fields under siege by the boll weevil became unprofitable and many fields were abandoned and subjected to severe degradation by erosion. In the Great Plains, an extended period of drought rendered the land non-productive and subject to soil loss by wind erosion. In other parts of the world, slash and burn agriculture continues to mine the soil of available nutrients necessitating the abandonment of those fields and in many cases inflicting severe damage to the soil and the environment.

Even today it is possible to view a high-yield field well protected from erosion by a thick layer of crop residue cover. Across a fence is another field showing exposed soil and evidence of soil and water loss. The difference is not due to the fence, but to the management received by each field. It is not the natural fate for the fields to differ, but they reflect the ability of farmers to improve productivity and environmental status. It is not the farmer's lack of desire, but often the financial inability to implement the management of the land in a productive, profitable, and environmental protective manner.

#### Crop stress erodes environmental protection

Decades of scientific research document that well nourished plants can better withstand the stress rendered by drought, diseases and, to some degree, extremes in temperature. Data show that high yielding crops also generate more crop residue in the form of roots and above-ground vegetation. Such residues not only serve as a shield against soil loss by erosion, but they serve as an energy source for soil microorganisms and as an ingredient essential for building soil productivity. The research also provides the knowledge which allows the farmer to understand how each nutrient essential for plant growth contributes to improved crop yield and profitability.

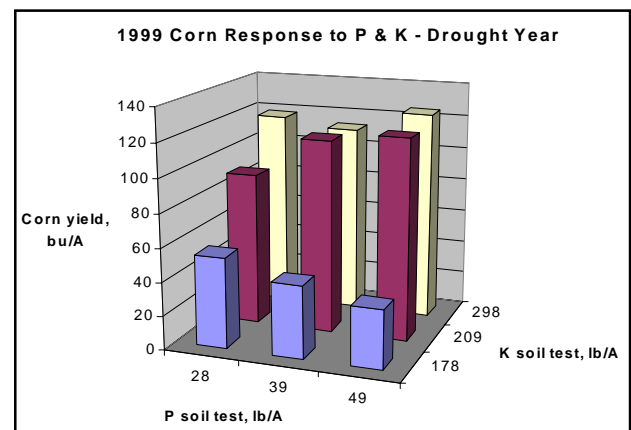
Phosphorus (P) and potassium (K) are two of the 17 elements essential for plant growth. They are vital to farm profitability and to the proper use and

protection of soil and water resources. Their contributions can be traced not only to specific functions performed, but also to the beneficial interactive relationships with other inputs and to their influence on crop tolerance to stress.

#### Phosphorus and potassium help to develop high yield potential by reducing moisture stress

Research documents that drought has less influence on crop yield when P and K are readily available throughout the growing season. This is due in part to their influence on (1) earlier and deeper root growth, (2) faster regrowth of stressed root systems, (3) availability during critical plant growth periods, and (4) efficiency of use of available water throughout the season.

The value of maintaining highly fertile soils is illustrated by long-term research conducted by Ohio State University scientist, Dr. Jay Johnson. Severe drought in south-central Ohio in 1999 resulted in corn yields in the 40 to 70 bushel per acre range. However, as shown in **Figure 1**, corn yield was improved nearly two-fold where soils tested higher in P and K. This study also illustrates another key concept ... nutrient balance. Without adequate K, crop response to higher levels of soil P did not develop. The highest grain yield was harvested from soils highly fertile in both P and K.



**Figure 1. Corn response to varying levels of soil test P and K (1999)**

## Phosphorus and potassium build crop resistance to certain diseases

Disease resistance has long been recognized as a benefit from a balanced Nitrogen (N), P and K nutrition program. Potassium's contribution to specific disease resistance is illustrated in **Table 1** for several different crops. Virginia scientists found that P and K as a team increased soybean yield from 24 to 34 bu/A while providing improved resistance to pod and stem blight as well as *Cercospora* induced purple stain on seed.

**Table 1. Plant diseases related to potassium deficiency.**

Cotton	Stemphylium leaf spot
Soybeans	Cercospora (purple seed), pod and stem blight
Corn	Southern corn leaf blight
Turf	Dollar spot
Wheat/Rice	Leaf rust

Dr. Glen Harris of the University of Georgia recently confirmed that K deficiency in cotton is linked to a leaf spot disease caused by *Stemphylium*. The leaf cells of K-deficient cotton were found to be susceptible to secondary fungal infections. Dr. Harris reported that cotton is sensitive to K deficiency. Almost every case of leaf spot investigated recently in Georgia involved low soil K, low petiole K, and/or low plant tissue K. He suggests avoiding K deficiency by maintaining soil test levels in the medium to high range, split applying K needs on sandy soils (half preplant and half at first square), and, when necessary, applying supplemental K through foliar fertilization.



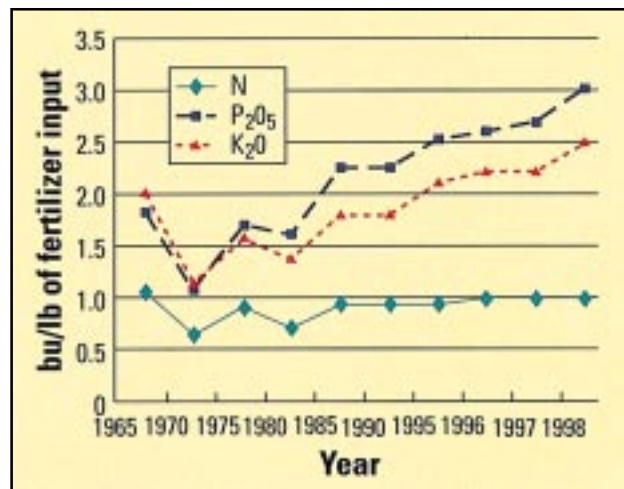
*Leafspot disease symptoms on K-deficient cotton leaves.*

## Input use efficiency is key to high yield, profitability and the environment

Efficient use of nutrients applied to crops continues to improve as farmers adapt new technology, improve crop yield, adjust production practices

for improved residue management, and target nutrient applications to crop need by growth stage. This translates into a larger percentage of applied nutrients being taken up by the crop and less remaining unused and available to potentially impact the environment. As recently emphasized by Dr. Bob Darst and Dr. Paul Fixen of the Potash & Phosphate Institute, "Efficient crop fertilization and nutrient management are integral to the production of profitable, high yielding crops."

As shown in **Figure 2**, farmers are doing a better job managing corn for improved use of applied NPK. This is believed due in part to the combined use of production system improvements such as (1) balancing nutrient applications to avoid a shortage of one nutrient from restricting crop use of another, (2) split applications of nutrients to minimize soil fixation or loss by leaching, and/or (3) improved matching of rate applied with actual crop need.



**Figure 2. Corn nutrient use efficiency continues to improve.**

## High yield production is environmentally sound

High crop yield management automatically includes environmental stewardship. This relationship exists due to certain conditions beneficial to both. Lets consider, for example, the environmental benefits generated within a field of high yielding corn which includes science-based best management practices.

*It is an efficient air cleaning system...utilizing carbon dioxide (CO<sub>2</sub>) and atmospheric sulfur (S) while releasing oxygen (O<sub>2</sub>) back into the atmosphere.*

*It rapidly covers the field with its leaf canopy...protecting the soil from the erosive force of raindrops and allowing a greater portion of the rain to enter into the soil.*

*It includes the miracle of photosynthesis...* creating a massive amount of vegetative and re-productive tissue. When properly fertilized and managed these tissues represent a dense, soil binding root system and up to 10 tons of leaves, stems and roots on each acre of land. It is this residue that holds nutrients, provides protective cover during the winter months, and which energizes soil microbes to bio-degrade crop protection chemicals and to decompose the residue to release nutrients and improve the internal structure of the soil.

*It is an efficient user of raw materials...* allowing high yield farmers who are input-cost conscious to better utilize crop protection materials and nutrient sources in a compatible manner that results in high input use efficiency and effectiveness.

*It adapts to improved knowledge and technology...* encouraging farmers to benefit from adopting conservation tillage practices, genetically improved varieties, buffer strips along streams, and other such practices which allow fewer trips over the field, less fuel consumption, and lower equipment costs.

## **Profitability improves with the commitment to higher crop yields**

High yield crop production is not without significant input costs. A greater cost to the farmer and the environment is to not invest wisely in the basic inputs essential for high yield, profitable production. Today's economic stress resulting from climatic conditions or low crop prices can tempt the farmer to cut back even on inputs essential to high yield crop production. Indiscriminate cost cutting can be detrimental to the consumer's food supply, to the farmer's economic well being, and to the best protection of the quality of our environment.

The environment is a major beneficiary from fertilizer use and a profitable crop production system. Sound, unbiased science shows that mismanagement of fertilizer P and/or N can lead to water quality problems. That same science also reveals the vast array of benefits that result from the judicious use of fertilizer in a high-yield and profitable crop production system. ■

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