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Band vs. Broadcast Application of Fertilizer

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Current fertilizer prices coupled with other increased production costs have renewed interest in band applications of fertilizer as a means of lowering fertilizer costs while maintaining crop yields. Fortunately, much basic soil fertilizer research has been conducted over the years which provides an understanding of the relative merits of band and broadcast placement. The following discussion outlines the basic considerations involved in deciding which of these two placement methods may be more economically useful for specific crop production systems. To better understand these considerations, certain principles related to adding fertilizer to the soil should be kept in mind. These are somewhat interrelated but will be discussed under the headings of nutrient mobility, reactions with soil, and soil nutrient levels.

Soil Nutrient Mobility: Plant nutrient elements may be broadly classified as mobile or immobile. The mobile nutrients are those that react very little with soil when applied as fertilizers, and as a result, move relatively freely through the rooting zone, usually in the net direction of water movement. Nitrogen is the most important of the mobile nutrients. Immobile nutrients are those which react with soil to form reaction products which are less soluble than the original solubility of the fertilizer nutrient applied. The most notable of these are phosphorus, sulfur, molybdenum, zinc, and manganese. Other immobile nutrients such as potassium, calcium, and magnesium react with the soil cation exchange complex. Although these are held somewhat strongly, they still move slowly through the rooting zone, particularly under leaching conditions and in soils of low cation exchange capacity. Since mobile elements can move over relatively large distances (a few inches) and immobile elements only small distances (tenths of an inch), banding immobile nutrients near the plant would be more effective than banding mobile elements.
Nutrient elements move to plant roots principally by mass flow and diffusion. Mass flow is movement by water as it moves. The plant needs for N, Ca, and Mg can largely be met by this mechanism. Diffusion is movement from areas of high concentration to areas of low concentration. Most of the P and K are supplied to the roots by this mechanism. Several factors influence rates of diffusion. Since diffusion is greater with warm temperatures and high soil moisture contents, the banding advantage would be expected to be greater in cool seasons (or climates) and relatively low soil moisture levels.

Reactions with Soils: The greater the degree of mixing fertilizer with soil, the greater degree of reaction between fertilizer and soil. Because of this, immobile nutrients will react more rapidly to less soluble form when broadcast and mixed into soil than if concentrated into a band. This is particularly true when soils are excessively acid or alkaline. Acid soils have high concentrations of soluble aluminum and iron that fix phosphorus, and molybdenum in unavailable forms. Alkaline soils fix phosphorus, manganese, zinc, and other in unavailable forms.

Soil Nutrient Levels: Growth response to added fertilizer nutrients is directly related to the available amount of those nutrients already present in the soil. For this reason, soils having a medium or higher content of available nutrients are not likely to show a large growth response to fertilizer additions of those nutrients, and therefore it is immaterial whether the added fertilizer is banded or broadcast. If soils are below the low-medium content, there will likely be a growth response to fertilizer addition of those nutrients, and banded fertilizer under such conditions will be more efficient.

No-Till Fertilizer Application: Research in Kentucky has shown that surface broadcast applications of phosphate and potash are as efficiently used by no-till corn as conventionally broadcast or banded applications...even on low-testing soils. A broadcast application of fertilizer to the soil surface for no-till corn is in reality a horizontal band application. Data from other states have shown the same for no-till soybeans.

Summary: Banding fertilizer decreases the surface area of fertilizer exposed to soil. This results in fertilizer nutrients in and near the banded site existing in a more available form for a longer period of time than if broadcast. This phenomena is economically useful in low testing soils if the band is placed so that plant roots intercept it, since lower rates of fertilizer can be used than if broadcast. Generally speaking, research results have shown under such conditions that only one-half to two-thirds as much fertilizer is required when banded as compared to broadcast. At medium or high soil test levels, broadcast rates are generally as effective as banded rates.