by Dr. Stanley A. Barber

Timing And Placement One Key to High Yields

Purdue scientist shows how strip placement of fluids is superior to broadcasting.

***Summary**: Using an intermediate degree of mixing, accomplished via strip treatments, has proven the more efficient placement. This method of placement is definitely worth considering in the pursuit of attaining greater yield responses from fluid fertilizers. Timing of fertilizer application is very important for the nitrogen part of the fluid fertilizer Timing is not as important for phosphate and potassium, whereas placement is more important. Placement is not nearly as important for nitrogen because it can move through the soil and be available to the plant as long as it is in moist soil and not on the dry surface.*

The efficient use of fluid fertilizers to produce high yields depends upon proper time of application and proper placement in the soil. Fluid fertilizers, which are generally known for their nitrogen, phosphate, and potassium formulations, need to be applied so they are available in the soil at the root surface when plants need them. Since operations must be timed so they don't interfere with planting, etc., estimates must be established on how far in advance the fertilizer can be applied without losing its effectiveness.

Move differently

Timing and placement factors for nitrogen are different from those for phosphate and potassium. Thus, when using a fluid fertilizer containing all three nutrients, account must be made of what will happen to all three after application. Biggest difference is movement.

Nitrogen. Nitrate will move with water in the soil. Hence, when applying nitrogen, leaching and denitrification are concerns. This usually means nitrogen must be applied near the time of use or else applied in the ammonium form if applied earlier. Ammonium doesn't move far in the soil but it will nitrify to nitrate if conditions are favorable. Nitrate can be lost by leaching or denitrification. Denitrification occurs under waterlogged conditions.

Phosphate/potassium. Phosphate usually moves in soil less than one-tenth of an inch and potassium less than two- to three-tenths of an inch. Hence, these nutrients have to be applied where the roots are. Applying fertilizer on the surface after planting will not be effective. Approximately 30 to 60 percent of corn roots and 40 to 70 percent of soybean roots may be in the plow layer. Fertilizer should be banded into the moist soil of this layer.

Feed from soil

Corn roots are usually about one-quarter to one-third of an inch apart in the plow layer. On the average, corn roots are farther apart because soybean roots are less than half the length of corn roots. Since the soybean roots are separated by twice the distance phosphate can move, little of the phosphate will reach the roots. Most will remain in the soil for uptake by future crops. This is why with phosphate, and to some extent potassium, the primary function of a fertilization program should be to maintain a satisfactory level of these nutrients in the soil. Plants are not being fed with applied phosphate and potassium as much as a level of these nutrients is being maintained in the soil. Thus, corn and soybeans feed from the soil. Unlike nitrogen, phosphorus and potassium are not directly used or uptaken by the crop.

Absorb what is near

Plant roots have a finite capability for absorbing nutrients. The rate at which a root segment absorbs nutrients increases as the level of nutrient around it increases, until it reaches a maximum. An example of this for phosphate uptake by corn roots is shown in Figure 1. The maximum uptake is at a lower concentration than is usually found near a fertilizer band. Hence, phosphate needs to be present throughout the soil around most of the roots. From the standpoint of the plant root, it is better to distribute fertilizer uniformly throughout the part of the soil where most of the roots are growing.

Plant roots usually absorb at two-thirds to three-fourths of the maximum rate in order to get nutrients needed for maximum yields. Hence, if the soil is low in phosphate, it should be mixed

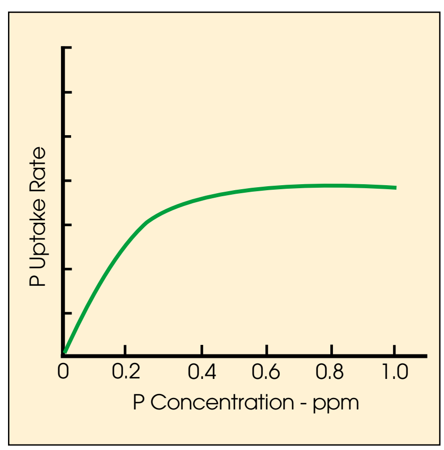

Figure 1. Relationship between phosphate in solution at the root surface and the rate phosphate is taken up by corn roots, Barber, Purdue University.

with a large volume of soil to reasonably supply all roots. Where plants are younger and uptake is faster, an even higher concentration near roots may stimulate additional growth.

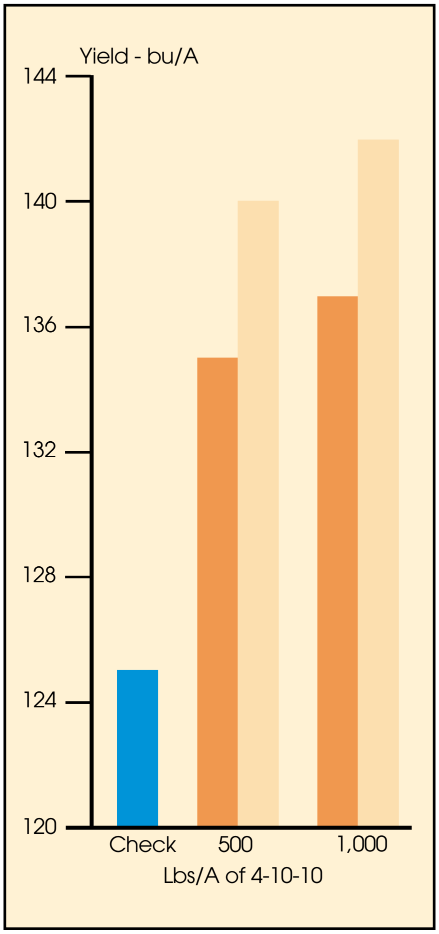

Figure 2. Corn yield response to strip versus broadcast of a 4-10-10 fluid fertilizer, Wanatah, IN, Barber, Purdue University.

React with soil

The only reason to band apply phosphate or potassium rather than broadcast and mix with the plow layer is that either can be fixed into unavailable forms by reaction with the soil. When broadcasting, these nutrients are essentially contacting all of the soil. By applying as a band, less fertilizer soil contact occurs and less fixation occurs. An additional benefit of some localization is to provide a higher fertility level when plants are young.

Though soil fixation is reduced by banding, it also results in these two fertilizers being mixed with only two or three percent of the soil. Hence, too few roots are contacted for the fertilizers to be effective.

An intermediate placement between these two extremes that has proved more effective, and is the focus of our research, is something we call strip placement.

Bumps yields

In order to get fertilizer mixed with only 10 to 20 percent of the soil in our experiments, strips of fertilizer three to four inches wide were applied at 28- to 30-inch intervals on the surface of the soil before fall plowing. During plowing, the strips were mixed with a portion of the soil. It was not a uniform mix and degree of mixing depended on conditions during plowing. Strip treatments were compared with broadcast applications. Our approach was to develop ways of applying fluids in the least quantities required to attain high yields. The smallest amount this could be, without mining the soil, waste replace exactly what was removed by the crop harvested.

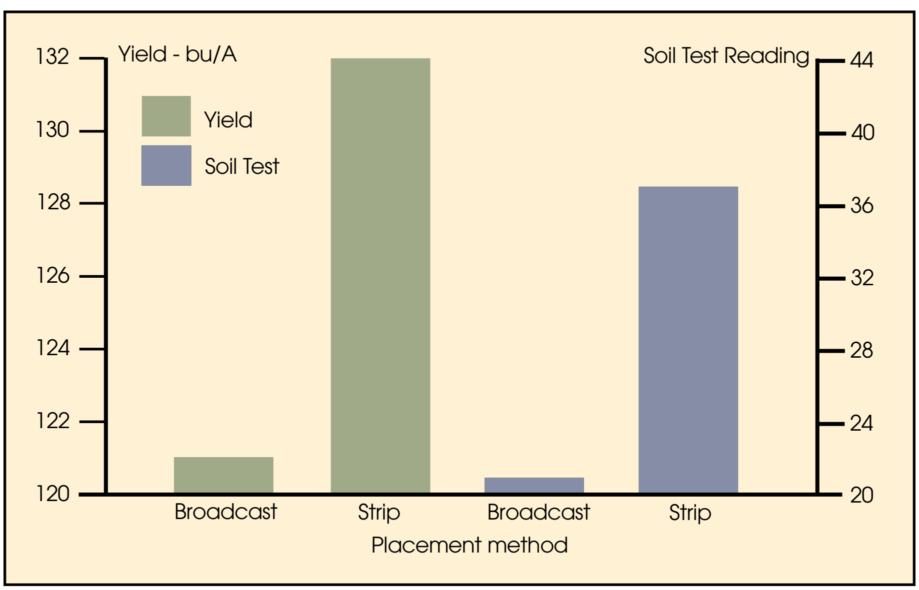

Figure 3. Average corn yields in a five-year comparison study of strip versus broadcast, Barber, Purdue University.

Location of one of the experiments we'll cite in this report was Wanatah in northern Indiana. Soil was a sandy loam. Fertilizer source selected to investigate the influence of placement was a 4-10-10 fluid. As can be seen in Figure 2, strip placement was superior to broadcast.

At another site where we conducted experiments for five years, average yields reported were as shown in Figure 3. At this site, soils were also sampled. Test results showed that strip treatments produced the highest average soil test.

The results of our fertilizer experiments have supported the general principles already discussed. Using an intermediate degree of mixing, accomplished via strip treatments, has proven the more efficient placement. Fertilizer reaches a greater proportion of the root system and is not tied up as much by the soil as occurs with broadcast applications. The use of strip treatments, versus the extremes of banding and broadcasting, is definitely worth considering in the pursuit of getting greater yield responses from applied fluids.

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Placement is not nearly as important for nitrogen because it can move through the soil and be available to the plant as long as it is in moist soil and not on the dry surface.

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