Fertilizer and Liming Practices
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No Till Corn: 2

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Fertilizer placement in a no-till system has been of some concern for several years. The problem is that no-till methods do not offer a means of incorporating large amounts of fertilizer or lime. Some data suggest that incorporation is not as essential as with other methods of tillage because roots are closer to the surface of the soil.

Phosphorus and Potassium Movement

Research has shown that surface-applied phosphorus moves no more than 2 or 3 inches from its original placement. Leaf analysis, however, shows comparable nutrient uptake between several tillage systems.

Supporters of the no-till concept offer the following explanation for the success of surface-applied phosphate. Less fixation of phosphorus occurs on the surface, which results in increased availability. Also higher soil moisture levels, due to the mulching effect of crop residues, allow for greater utilization of phosphorus. Similar theories are advanced for potassium, but movement of potassium is greater than that of phosphorus.

When taking soil samples, farmers should be aware of the differences of phosphorus and potassium movement patterns. Take soil samples to a normal plow depth and mix thoroughly to assure a valid interpretation of the **fertilizer** and **lime** recommendations.

Fertilizer Placement

Research on fertilizer placement shows that band applications of phosphorus are particularly important where soil phosophorus tests are low and soils are cold. Proper placement of starter fertilizer may be more difficult with the conventional no-till planters. As a result, it may be desirable to place fertilizer slightly more than 2 inches to the side, and 2 inches below the seed, to insure good seed germination and avoid fertilizer injury. Some farmers have solved the problem by widening the tillage strip through the use of two fluted coulters.

Nitrogen Application

Surface-applied nitrogen normally does not cause problems because nitrogen fertilizers are soluble and move downward with water. Nearly all nitrogen fertilizers are acid forming, and consequently, the soil surface can very rapidly become acidic. Since the availability of phosphorus *in the surface area* is also affected by the soil pH, it may be advisable to lime more frequently with smaller amounts of lime or plow every 3 or 4 years to incorporate lime and fertilizer nutrients.

Anhydrous ammonia has been successfully used in the no-till system and will reduce the need for frequent liming because it is incorporated rather than surface applied. Applicator knives should be equipped with rolling coulters ahead of each knife and a packer wheel behind to prevent escape of ammonia from the slit made by the knives. Applying urea or 28 percent nitrogen (50 percent urea) solution to crop residues may also result in sizable losses of nitrogen by ammonia

No-till corn planted in heavy corn stubble. **SCS Photo**

volatization, especially if temperatures are warm. Ammonium nitrate may be the best source of nitrogen for surface application on heavy residues.

Surface-applied nitrogen also has a greater possibility of being tied up in organic residues. Consequently, 10 to 20 percent more nitrogen may be required where residues are encountered. Surface residues keep soil temperatures cool and reduce evaporation, but they may also contribute to leaching or runoff losses in years of excess moisture. On fine-textured soils, the excess moisture may increase denitrification by prolonging water-logged conditions.

Soil Fertility Levels

Since large applications of fertilizer and lime cannot be incorporated into the soil in a continuous no-till system, it is desirable to start with a high level of soil fertility. If soil fertility levels are not medium or high initially, plowing every 3 or 4 years may be necessary to incorporate the required amounts of phosphorus and potassium.

Phosphorus

Phosphorus levels of Michigan soils are well suited for no-till corn production. Soil test summaries indicate that over 50 percent of all soils used for growing corn have high available phosphorus levels (greater than 60 pounds P/A). Soil phosphorus levels above 60 pounds per acre are necessary to produce 100 plus bushels of corn per acre. Banding 25 pounds P_2O_5 per acre at planting time on soils testing high in phosphorus will provide the potential for 150 bushels per acre. Forty percent of the loams, clay loams and silty clay loams soils tested in 1974 for corn production had phosphorus levels above 60 pounds per acre. Similar figures for the sandy loams, loamy sands and sands are 56, 67 and 65 percent, respectively.

When the phosphorus level is medium to high, all the necessary phosphorus can be banded near the seed (2 inches to the side and 2 inches below) at planting time. Up to 100 pounds per acre of potash can also be banded at planting time. Band-applied phosphorus eliminates the uncertainty about whether surface-applied phosphorus will become available to the active growing roots.

Potassium

The surface application of potassium to loams, sandy loams and sands which are best suited for no-till operations will remain sufficiently mobile to move into the active root zone. Michigan corn soils, however, are relatively lower in potassium than phosphorus. Fifty percent of all soils used for corn production in 1974 had available potassium levels of less than 160 pounds per acre (a medium level) and required 100 pounds or more of potash per acre to produce 120 to 150 bushels of corn per acre. Of the loams, clay loams and silty clay loam soils, 45 percent had potassium test levels below 160 pounds K per acre. Figures for sandy loams, loam sands and sands were 46, 47 and 29 percent, respectively. Michigan soils best suited for no-till corn production should receive careful attention with respect to potash fertilization.

Lime

Many of the soils best suited for no-till are in need of lime. Maintaining soil pH between 6.0 and 6.5 allows for maximum nutrient availability. According to Michigan State University soil test summaries, 36 percent of the sand soils used for corn production in 1974 and pH's below 6.0. Twenty-eight percent of the loamy sands and 23 percent of the sandy loams had pH's below 6.0 compared to 18 percent for the loams, clay loams and silty clay loams and similar soils. Determining lime requirements and incorporating needed lime is desirable before going to no-till. Surface-applied lime is not very effective in neutralizing soils acidity in the active root zone.

Soil Testing

A regular soil testing program should be an essential part of any corn production method, including no-till. Soil samples should be taken every second or third year to insure good soil fertility is being maintained. Take soil samples 8 to 9 inches deep with one composite sample representing not more than 15 acres. (See Extension Bulletin E-498, "Soil Sampling," available from your county extension office or the MSU Bulletin Office, P.O. Box 231, E. Lansing, MI 48824.) If soil pH or nutritional levels have decreased, incorporation of lime and more fertilizer may be necessary to build up the soil pH, phosphorus and potassium levels.

Summary

When moisture and/or residues are adequate, surface-applied fertilizer can be effectively utilized. Under conditions of limited residue and/or low rainfall, no-till corn yields may be reduced compared to the conventional tillage system. Surface-applied nitrogen accentuates surface soil acidity, while surface-applied phosphorus and potassium accumulate in the surface 2 or 3 inches. For these reasons, it may be advisable to build soil test levels to medium or high levels before going to a continuous no-till program, or plow every 3 or 4 years to mix lime and fertilizer throughout the plow layer and loosen the soil. The no-till system is not recommended on low fertility or strongly acid soils.

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