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Best Management Practices: Using Starter Fertilizer

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For many years, some of Ohio's corn and soybean growers have been using starter fertilizers at planting time as part of their total fertilizer program. While there is no question that there are benefits from using starter fertilizer, it is important to examine the factors that determine when conditions justify their use.

In this fact sheet, starter fertilizer will be referred to as fertilizer that is banded near the seed, in the soil at planting time. Most planter equipment is set to apply starter in a 2 by 2 placement, or 2 inches to the side of the seed and 2 inches below. In Ohio, producers are using liquid ammonium polyphosphate (10-34-0), urea-ammonium nitrate (28-0-0), dry diammonium phosphate (18-46-0), or monoammonium phosphate (11-52-0) as starter fertilizers. Potassium fertilizer or micronutrients are occasionally blended into the starter fertilizer.

This fact sheet will discuss the factors that determine the need for starter fertilizer and aid as a guide in deciding where to use starter fertilizers. These factors are:

- The crop grown
- Soil temperature and moisture
- Tillage system
- Soil test levels
- Soil organic matter
- Soil pH
- Root restrictions
- Management decisions

The Crop Grown

Corn will respond to additions of P fertilizer more than soybeans, and soybeans will respond to additions of K fertilizer more often than corn. The P and K requirements for optimum yield in Ohio differ between

corn and soybeans. Table 1 shows that the phosphorus soil test for optimum yield for corn is 40 versus 30 for soybeans. This would indicate that soybeans are much less likely than corn to show a yield response to starter P, because the K soil test required for soybeans is much higher than corn, a soybean crop would have a greater probability of showing a yield response to starter K fertilizer than would corn.

Nitrogen starter for corn may be justified, depending upon whether there is adequate N present in the soil at planting. More will be discussed on this in the following sections. A soybean crop will usually not respond to N starter because of the soybean's ability to produce N through bacterial nitrogen fixation.

Table 1: Soil Test Required for Optimum Yield in Ohio

Soil Test Level				
Crop	P_1	Exchangeable K C.E.C. (MEQ/100 g)		
		10	20	30
Corn	40	265	315	370
Soybeans	30	325	375	425

Soil Temperature and Moisture

Soil temperature is a major factor affecting the availability of plant nutrients. As soil temperatures rise, more N and P is mineralized from the organic matter in the soil. Plant roots also grow more rapidly and have a greater ability to absorb nutrients. During the growing season, adequate soil moisture is critical to plant growth. However, in early spring wet soils tend to stay cool and have a lower capacity to release plant nutrients. Hence, starter fertilizers used on cool, wet soils will have a higher potential for providing yield responses.

Tables 3 through 8 list the potentials for corn yield responses to starter N and P for southern, central, and northern Ohio. Soil temperature differences during the planting season are demonstrated by dividing the state into these three sections at various planting dates. Expected soil temperatures for those sections of the state are shown in Table 2.

As shown in the tables, when soil temperatures approach 55, there is a lower potential yield response from starter fertilizer.

Table 2: Expected Ohio spring temperatures

Plant Date	April 15	May 1
Northern Ohio	49	55
Central Ohio	53	58
Southern Ohio	53	61

Tillage System

Minimum tillage fields stay much cooler in the spring than conventional tillage field. The higher amounts of residue and their slow drying nature keep temperatures lower. Hence, there is a higher potential for yield responses to starter fertilizer in the early spring on minimum till fields.

Where broadcast applications of P and K are made on the soil surface in continuous no-till, soil test levels for P and K are often reduced in the root zone by crop removal. Where this occurs, there is a

potential for yield responses to starter fertilizer. P and K applied to the soil surface and not mixed in the plow layer tend to stay very near the soil surface on most Ohio soils. When using starter fertilizer in these situations, it is critical that the fertilizer attachment is capable of placing the fertilizer below the seed.

Soil Test Levels

Table 1 shows P and K soil test levels necessary for optimum corn and soybean production. At these soil test levels, we would not expect yield increases due to further P and K fertilizer additions. However, in colder soils (northern Ohio) and a minimum till situation, there is a moderate potential for grain yield increases due to starter fertilizer use, even on soils testing high in P or K (see table 5).

Where soil fertility is low in general, yield increases can be expected when using starter fertilizer. Starter fertilizer can be a more economical choice than broadcast application, since the same effect can be obtained by using less fertilizer in a concentrated band than would be recommended as an annual broadcast application. When using starter fertilizer, rates of application can be reduced by as much as 20 to 40%. Table 9 shows the rates of starter fertilizer needed in place of an annual broadcast recommendation.

Soil Organic Matter

Soil organic matter influences N and P availability to the plant. Dark soils, as indicated in tables 3 through 8, are those with a higher organic matter content. Light soils are those with a lower organic matter content. As soil warms in the spring, biological activity increases in the organic fraction of the soil. As biological activity increases, some N is mineralized (released as an available form) and the organic pool of available P is increased. Hence, in darker soils the potential for yield response due to the use of starter fertilizer is reduced, compared to lighter colored soils low in organic matter.

Soil pH

The soil pH affects the relative availability of plant nutrients, especially phosphorus. As the soil pH drops below 6.0 the availability of soil P begins to drop dramatically. Phosphorus becomes tied-up in chemical complexes with aluminum and iron that are not available to the plant. Liming soils to a near neutral pH is the best practice to solve this problem. However, when liming is not possible, P starter fertilizers can be of a significant benefit, particularly on soils testing low in P.

Root Restrictions

Plant roots can be restricted by soil compaction and by herbicide carryover. When plant roots are restricted, nutrient availability to the plant is reduced. Obviously, preventative measures to reduce soil compaction and herbicide carryover are the best practice to avoid restricted root growth. When a grower is faced with either of these two problems, the use of starter fertilizer may improve the situation by providing a nutrient source in a concentrated band near the seedling.

Table 3: The probability of corn yield response to starter phosphorus in southern Ohio[1].

Date	Soil Test P[2]	Minimum Tillage		Conventional Tillage	
		Dark Soil	Light Soil	Dark Soil	Light Soil
	< 20	High	High	High	High

Before 4/15	20 - 40	Moderate	Moderate	Low	Moderate
	> 40	Low	Low	Low	Low
4/15 - 5/1	< 20	Moderate	High	Moderate	Moderate
	20 - 40	Low	Low	Low	Low
	> 40	Low	Low	Low	Low
After 5/1	< 20	Moderate	Moderate	Moderate	Moderate
	20 - 40	Low	Low	Low	Low
	> 40	Low	Low	Low	Low

[1] The area of Ohio south of interstate 70.

[2] Soil test of phosphorus lbs/acre.

Table 4: The probability of corn yield response to starter phosphorus in central Ohio[1].

Date	Soil Test P[2]	Minimum Tillage		Conventional Tillage	
		Dark Soil	Light Soil	Dark Soil	Light Soil
Before 4/15	< 20	High	High	High	High
	20 - 40	Moderate	Moderate	Moderate	Moderate
	> 40	Low	Low	Low	Low
4/15 - 5/1	< 20	High	High	Moderate	High
	20 - 40	Moderate	Moderate	Low	Moderate
	> 40	Low	Low	Low	Low
After 5/1	< 20	High	High	Moderate	Moderate
	20 - 40	Moderate	Moderate	Low	Low
	> 40	Low	Low	Low	Low

[1] The area of Ohio north of interstate 70 and south of st. route 30.

[2] Soil test of phosphorus lbs/acre.

Table 5: The probability of corn yield response to starter phosphorus in northern Ohio[1].

Date	Soil Test P[2]	Minimum Tillage		Conventional Tillage	
		Dark Soil	Light Soil	Dark Soil	Light Soil
Before 4/15	< 20	High	High	High	High
	20 - 40	High	High	Moderate	Moderate
	> 40	Moderate	Moderate	Low	Low
4/15 - 5/1	< 20	High	High	High	High
	20 - 40	High	High	Moderate	Moderate
	> 40	Moderate	Moderate	Low	Low
After 5/1	< 20	High	High	High	High
	20 - 40	Moderate	Moderate	Low	Moderate
	> 40	Low	Low	Low	Low

[1] The area of Ohio north of st. route 30.

[2] Soil test of phosphorus lbs/acre.

Table 6: The probability of corn yield response to starter nitrogen in southern Ohio[1].

Date	Soil Test P[2]	Minimum Tillage		Conventional Tillage	
		DarkSoil	Light Soil	Dark Soil	Light Soil
Before 4/15	PP	Low	Low	Low	Low
	BD	High	High	Moderate	High
	SD	High	High	High	High
4/15 - 5/1	PP	Low	Low	Low	Low
	BD	Moderate	High	Low	Moderate
	SD	High	High	Moderate	High

[1] The area of Ohio south of interstate 70.

[2] PP = Preplant broadcast nitrogen applications, including anhydrous ammonia applied one week prior to planting.

BD = Banding nitrogen at planting.

SD = Sidedress nitrogen applications after crop emergence.

Table 7: The probability of corn yield response to starter nitrogen in central Ohio[1].

Date	Soil Test P[2]	Minimum Tillage		Conventional Tillage	
		DarkSoil	Light Soil	Dark Soil	Light Soil
Before 4/15	PP	Low	Low	Low	Low
	BD	High	High	Moderate	Moderate
	SD	High	High	Moderate	High
4/15 - 5/1	PP	Low	Low	Low	Low
	BD	Moderate	High	Low	Moderate
	SD	Moderate	High	Moderate	High

[1] The area of Ohio north of interstate 70 and south of st. route 30.

[2] PP = Preplant broadcast nitrogen applications, including anhydrous ammonia applied one week prior to planting.

BD = Banding nitrogen at planting.

SD = Sidedress nitrogen applications after crop emergence.

Table 8: The probability of corn yield response to starter nitrogen in northern Ohio[1].

Date	Soil Test P[2]	Minimum Tillage		Conventional Tillage	
		DarkSoil	Light Soil	Dark Soil	Light Soil
Before 4/15	PP	Low	Low	Low	Low
	BD	High	High	Moderate	Moderate
	SD	High	High	High	High

4/15 - 5/1	PP	Low	Low	Low	Low
	BD	Moderate	High	Low	Moderate
	SD	Moderate	High	Moderate	High

[1] The area of Ohio north of St. Route 30.

[2] PP = Preplant broadcast nitrogen applications, including anhydrous ammonia applied one week prior to planting.

BD = Banding nitrogen at planting.

SD = Sidedress nitrogen applications after crop emergence.

Management Decisions

A decision on the use of starter fertilizer is often made from a farm management perspective. Filling fertilizer boxes or tanks on a planter is very time consuming. Most agree that the time in the field planting the crop is very valuable time spent, since timeliness of planting is critical for optimum yields. Those farm operations that must cover large acreage with limited planting equipment may choose not to use starter fertilizer because of the time factor. In addition, fertilizers are very corrosive to metal machinery, which leads to higher maintenance and replacement costs.

Salt Injury

High levels of nitrogen and potassium fertilizer salts can be injurious to emerging seedlings. The total amount of salts (N and K_2O) placed 2 inches to the side and 2 inches below the seed should not exceed 100 lb/acre for corn or 70 lb/acre for soybeans planted in 30 inch rows. If the rows are wider or more narrow, the salt tolerance decreases or increases proportionally. The 2 inch by 2 inch or greater placement is generally preferred, however.

Conclusion

By understanding some of the basic soil-plant relationships and conditions under which starter fertilizer is most likely to provide a positive response in grain yield, growers can improve their farming operations. For assistance in making decisions about the use of starter fertilizers, growers are urged to contact their local Cooperative Extension Service office.

Table 9: Starter fertilizer rate conversion table K_2O and P_2O_5

Fertilizer Rate from Annual Recommendation	Fertilizer Needed when Starter Fertilizer is Used (lb / A)
0 - 40	Same as Annual Recommendation
50	45 [1, 2]
60	50
70	55
80	60
90	65
100	70
110	75

120	80
130	85
140	90
150	95
[1] At least 20 lb / A should be used with planter. The remainder may be broadcast.	
[2] Do not exceed total salt limit for crop growth.	

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