

production. The fertilizer recommendations are designed to provide both the small grain and the soybeans with adequate nutrients from a single application.

FERTILIZER DECISION-MAKING

Your soil test report contains only a suggested fertilizer program. It represents the best information available and considers crop, soil, and management factors to the extent that these are known. The grower has additional information available to them regarding management and field history as well as the field experience necessary to make management decisions. Modifications of the suggested fertilizer program may be appropriate. The grower must make the final decision whether or not to modify the fertilizer program for specific situations. When doing so, the following points should be considered:

1. The amount of fertilizer recommended is based on the best management practices currently in use and is designed to produce maximum economic yields assuming that no other factor such as temperature, moisture, disease, etc. is limiting yields.
2. When the soil test is very low or low, banding fertilizer will maximize yields immediately but will not raise the soil test level. Alternatively, broadcast applications at the appropriate rate will raise the soil test over a period of time but yields may not be optimal the first year. Where possible, a combination of the two methods may be the best practice.
3. When the recommended amount of P_2O_5 or K_2O is small, e.g., 20 lbs/A, the grower must identify the minimum amount that can be practically applied. Often a choice must be made between applying no fertilizer this year or applying a larger amount, e.g., 50 lbs/A, which will supply the crops for the next two years.
4. Changing the recommended amount of P_2O_5 or K_2O by 10 to 20 lbs/A seldom results in observable differences.

ADDITIONAL INFORMATION

Additional information may be obtained from University of Delaware Cooperative Extension offices in Newark, Dover, and Georgetown.

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SOIL TEST NOTES

NOTE 2: Grain and Silage Crops

LIME

Generally, incorporation and thorough mixing of limestone to a depth of at least 6 inches is necessary for best results. Uniform spreading is also critical, especially on sandy soils where overlining can lead to micronutrient deficiencies. The following are guidelines for lime applications under conventional tillage.

Applications of more than 2.0 T/A-- $\frac{1}{2}$ to $\frac{3}{4}$ of the lime should be spread, disked into the soil, and plowed under. The remainder can then be spread and disked in. This method results in good incorporation and mixing--important when the pH is low and the lime rate is high. This should be done as far in advance of planting as possible to allow time for the lime to react.

Applications of 2.0 T/A or less--All of the lime can be spread in a single application. At rates of 1.5 to 2.0 T/A, disking in the lime, followed by a plow-down and re-disking gives best results. For applications of 1.0 T/A or less, disking to 4 to 6 inches alone is usually adequate.

For no-till situations where incorporation is not feasible, surface applications can be effective when the rate does not exceed 1.0 T/A. When higher rates are required, it is best to plow or disk the no-till cover to make incorporation possible.

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NITROGEN (N)

Corn, Sorghum--Nitrogen use is most efficient when split into at least two applications. This is especially true during high-rainfall years or when the crop is irrigated. Nitrogen is readily leached out of the rooting zone during heavy rains or irrigation. This is especially true on very sandy soils, and more careful N fertilization is required. In general, 1/4 to 1/3 of the recommended N should be applied at planting as a broadcast, pre-emergence spray, or banded application. Sidedress the remainder when the crop is about 15 inches tall. For fields with a history of manure use, growers should consider using the Pre-sideress soil nitrate test for corn to fine-tune their sidedress rates. If an injection pump is available, the sidedressing can be done through the irrigation system in 2 to 5 applications. For corn, all the N should be applied before the brown silk stage.

Small Grains--Research in Delaware has shown inconsistent responses to fall-applied nitrogen on small grains. All of the recommended N should be topdressed in the early spring when growth resumes. Although the grain yield potential is lower on sandy soils, more N is needed because of greater leaching losses. If very heavy rains occur after topdressing N, it may be necessary to apply an extra 20 lbs/A N before the boot stage. Check the crop for signs of N deficiency before applying any extra N. Excessive N fertilization of small grains will cause lodging.

For more information on nitrogen fertilizers and their managements, see *Soil Test Note 5*. For information on the Pre-sideress Soil Nitrate Test for corn, see *Soil Test Note 14*.

PHOSPHORUS (P)

Most cultivated fields in Delaware test fairly high in phosphorus due to a long history of P fertilization. As a result, little or no P fertilizer is usually needed. Small amounts of P can be efficiently applied by banding 2 inches below and to the side of the seed at planting. Alternatively, the P can be broadcast and disked in or plowed under.

When the soil test P is very low, as it is on newly cleared land, it is best to broadcast 1/2 to 3/4 of the recommended P and plow it under. This assures there is a good level of P throughout the plow layer. Additional P can be banded or disked in.

Please note that P fertilizer recommendations for corn are for banded applications. If broadcasting, the rate given should be approximately doubled.

POTASSIUM (K)

Because potassium can leach out of the plow layer of Delaware's sandy soils, it is best to take extra care in fertilizing with K. Fall applications of K for spring-planted crops are not recommended on loamy sand soils. For winter small grains, applying 1/2 of the recommended K in the fall is necessary only when the soil test is low. Otherwise, spring topdressing of K is adequate and is the best practice when double-cropping with soybeans. This prevents leaching losses of K during the rainy winter months. The amount of K fertilizer recommended for small grain/soybean doublecropping is sufficient for both crops.

Potassium can be banded 2 inches below and to the side of the seed at planting. However, the N plus K₂O in the band should not exceed 60 lbs/A.

BANDED FERTILIZERS

Banding fertilizer is becoming a common practice, especially for corn production. Advantages to this practice include: (1) fewer trips across the field are required when planting and fertilizing can be combined into one operation; (2) utilization of banded fertilizer P is more efficient -- only about half as much P is needed as compared to a broadcast application; and, (3) banding N at planting is an efficient way to apply the small amount of N needed early in the season.

When the P soil test is high or excessive, no fertilizer P is recommended. Some growers may still choose to apply some banded N and P as a starter, or "pop-up", fertilizer. Starter fertilizer usually results in faster root and top growth early in the season, especially when the soil is cold and wet at planting. This condition prevails when the crop is planted early and/or under a no-till system. Whether or not starter fertilizer will increase yields depends on many factors and is difficult to predict. Personal experience and the capabilities of existing planting equipment must ultimately decide whether or not to use starter fertilizer. From the limited data available, it appears that starter fertilizer is of more benefit under no-till than under conventional tillage.

TRACE ELEMENT NEEDS

The only trace element deficiency on grain crops commonly found in Delaware is Mn on soybeans and small grains. Zinc deficiency is sometimes observed on corn grown in sandy soils with a pH of greater than 6.5. Sulfur additions to corn grown on sandy soils may be needed, particularly if the crop is irrigated. Research into these questions continues and the fertilizer recommendations will be updated as new evidence comes to light.

See *Soil Test Note 4* for a more complete discussion of trace element needs.

TILLAGE AND COVER CROPS

No-tillage production of corn and soybeans is rapidly becoming a standard practice in Delaware. The primary advantages of no-till are reduced energy costs for tillage and reduced moisture loss where a cover crop is present. In addition, nitrogen fertilizer costs can be reduced when a winter annual legume is grown before corn.

For corn, no-tillage production using a cover crop such as hairy vetch, rye, or oats usually results in a higher yield potential when the crop is not irrigated due to more efficient use of soil moisture. Because of the greater yield potential, more N, P₂O₅, and K₂O are recommended for a given soil type when no-tillage with a cover crop is used. If the crop is efficiently irrigated, yield differences between conventional and no-tillage tend to be small, and the fertilizer recommendations are the same for both systems.

When winter annual legumes such as hairy vetch, and crimson clover are grown before corn, less nitrogen fertilizer is needed. Legumes fix N from air in the soil to supply their N needs and, when killed, release this N in a form available to the crop. The N fertilizer applied to the corn crop should be reduced by 50 to 100 lbs/A depending on the amount of legume cover present at planting.

For soybeans, full-season, no-tillage production is beginning to replace conventional tillage on some farms. Yield increases due to this practice may occur but have not been documented and the fertilizer recommendations are currently the same for both practices. Double-cropping soybeans after small grains generally produces about 10 bu/A less soybeans than full-season