# Soil Test Nitrogen and Phosphorus Variability in the Texas Southern High Plains

By M. G. Hickey and A. B. Onken

*Texas data demonstrate variability in phosphorus (P) distribution in apparently uniform fields. Application according to grid sampling provides opportunity for increased input efficiencies and higher yields.*

**THE** Texas Southern High Plains represents about 25 percent of the planted cotton in the U.S. About 50 percent of the production area is farmed dryland, and the remaining cropland receives varying amounts of irrigation. Most of the farms are large, with individual fields generally 120 acres or more in size.

Many producers consider their fields to be quite uniform, but most generally recognize that yields vary across the field. From a soil series standpoint, many fields across the area are quite uniform. Soil fertility levels, however, can be quite variable on the small scale, a fact which can only be revealed through intensive soil sampling and geostatistical modeling.

## Ag-CARES Study

In this study, the Agricultural Complex for Advanced Research and Extension Systems (AG-CARES) in Dawson county, TX, was selected. The 160-acre AG-CARES facility has 120 acres irrigated (center-pivot system) and 40 acres devoted to dryland systems. The entire site is mapped as Amarillo fine sandy loam, with a 0 to 3 percent slope.

The AG-CARES site shown in **Figure 1** was subdivided into a 9x9 grid, with each block representing 2 acres. Three one-inch diameter cores were collected from near the middle of each block, and composited (only the 0 to 6 inch depth samples will be discussed). Composite samples were analyzed for soil test nitrogen (N) and P at the Texas Agricultural Extension Service Soil Testing Laboratory at Lubbock. The data were then subjected to an appropriate geostatistical model, and maps were developed.

Most Texas Southern High Plains fields are sampled in order to make a single fertilizer rate application. **Table 1** shows calculated field mean soil test N and P levels as a function of sample number. All concentrations were comparable across sampling number, and all had the same nutrient rating. These results would indicate that the 160 acre field was quite uniform.

**Table 1. Comparison of soil test N and P as a function of sample number and means of selecting samples.**

| | Soil test N, ppm | N Rating | Soil test P, ppm | P Rating |
|---|---|---|---|---|
| 5 Taken at Random | 2.2 | Very Low | 20 | Low |
| 10 Taken at Random | 2.3 | Very Low | 17 | Low |
| 25 Taken at Random | 2.6 | Very Low | 16 | Low |
| All 81 | 2.5 | Very Low | 6 | Low |

The soil test N distribution across AG-CARES was quite uniform, with only 10 acres rated higher than very low (**Table 2**). This result was expected, because of N uptake from the previous crop and downward movement of nitrate-N ($NO_3$-N) from the surface 6 inches in sandy soils. Adequate N fertilizer recommendations

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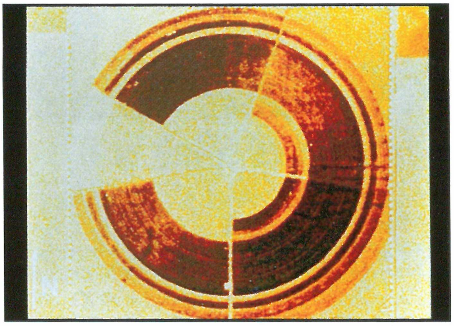

Figure 1. Aerial photograph of the AG-CARES facility, in Dawson county, TX.

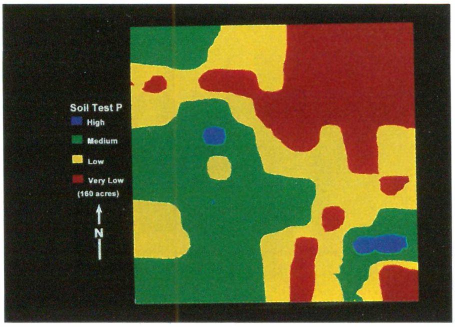


Figure 2. Map of soil test P distribution at AG-CARES, Dawson county, TX.

could be made with a relatively few soil samples. For 2 bale/A cotton, 95 lb N/A across the entire field would be recommended.

Unlike N, the soil test P distribution across AG-CARES was much more variable, as shown in **Figure 2**. The variation in soil test P was divided nearly evenly between very low, low, and medium (**Table 2**). The majority of acres testing very low in P were identified with the Northeast quadrant, that is characterized by a 3 percent slope. The areas testing low and medium had no visible characteristics. Two P "hot spots" were observed, but there is no readily apparent reason for their occurrence.

With the amount of spatial variability in soil test P across AG-CARES, a single rate fertilizer application could lead to loss of potential revenue. Based on the 25 random samples shown in **Table 1**, 25 lb $P_2O_5$/A would be recommended for 2 bale/A cotton. This would amount to about 4,000 lb $P_2O_5$ applied to the 160 acre field as a single application. If spatial variability is accounted for, the 45 acres testing very low would receive 65 lb $P_2O_5$/A, and the 53 acres testing low would have 25 lb $P_2O_5$/A applied.

**Table 2. Soil test N and P distribution based on 2 acre grid sampling and geostatistical mapping.**

| Soil test rating | Nitrogen, acres | Phosphorus, acres |
|---|---|---|
| Very Low | 150 | 45 |
| Low | 6 | 53 |
| Medium | 4 | 61 |
| High | <1 | 1 |

When the distribution of soil test P at AG-CARES is accounted for, no P fertilizer would be applied to the 62 acres testing medium and high, where no response is anticipated. If the single field rate were used, then about 1,550 lb $P_2O_5$ would be applied with no anticipated response. Use of the single field rate would have shorted the 45 acres testing very low by about 40 lb $P_2O_5$/A, which would have effected a reduction in the potential yield. When spatial variability is taken into consideration, 4,250 lb $P_2O_5$ would have been applied to only 98 acres, which is 250 lb $P_2O_5$ more than for the single field application rate. Moreover, yield potential and fertilizer P use-efficiency would be maximized. ■