Optimizing Nitrogen Sampling Techniques

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Summary

To optimize plant nitrogen sampling techniques one should collect petioles from the upper first or second fully expanded mature leaves. Areas sampled for plant or soil nitrogen should be as far apart as possible with sample areas not occuring on the same rows.

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Errors due to sampling are generally greater than those due to laboratory analysis. Even if laboratory results correlate perfectly with crop response, the results have little value if the samples are unrepresentative. (With this in mind the structure of sample variability on individual plants and in the field will be discussed.)

By analyzing different-aged single petioles, it was determined that the upper first, second and third, fully expanded mature leaves have similar nitrate concentration levels and sensitivity to nitrogen deficiency (1982 Cotton Report, pp. 39 and 40). This agrees with previous studies suggesting petioles from the first fully expanded leaf should be picked and also indicates the next older leaf should be picked if the degree of maturity is in question.

Sampling may be approached in two ways. In order to reduce bias and maintain consistency, sampling should be from the first, fully expanded mature leaf, but, if the degree of maturity is in question the next older leaf should be picked. A simpler approach is to sample from the second, fully mature leaf. This will insure only the first or second mature leaf is picked because degree of maturity is subjective and samplers sometimes collect younger-than-optimum petioles.

The application of geostatistical techniques to the analysis of soil and plant sample data indicates a spatial dependency of petiole nitrate and soil nitrate concentrations. That means samples taken close together are more alike than samples taken far apart. Quantification of this observation indicates samples along rows are more similar than samples across rows. This may be the result of irrigation or nonuniform application of fertilizer, causing bands of similar fertilizer concentrations along rows and groups of rows.

Modeling these relationships mathematically and applying them to the original data, results in a kriged map (figure 1) of petiole nitrate concentrations in this case. Kriging is a geostatistical technique where maps can be made using incomplete data from an area by optimumly interpolating estimated values between known data. Comparing the kriged map with an intensive soil map (figure 2) of the same 32 acre field illustrates that, even in fields with uniform soil, nonuniform petiole nitrate concentrations can be expected. Petiole samples and statistics from this particular field indicate that it is typical of the fields studied in the previous article. A three area-sample average will estimate this field's true average, within 1000 ppm NO_3-N 50% of the time, within 2000 ppm NO-N 60% of the time and within 3000 ppm NO_3-N 80% of the time.

In order to optimize plant or soil field averages area samples should be taken as far apart as possible and should not occur on the same rows even though they may be at opposite ends of the field.

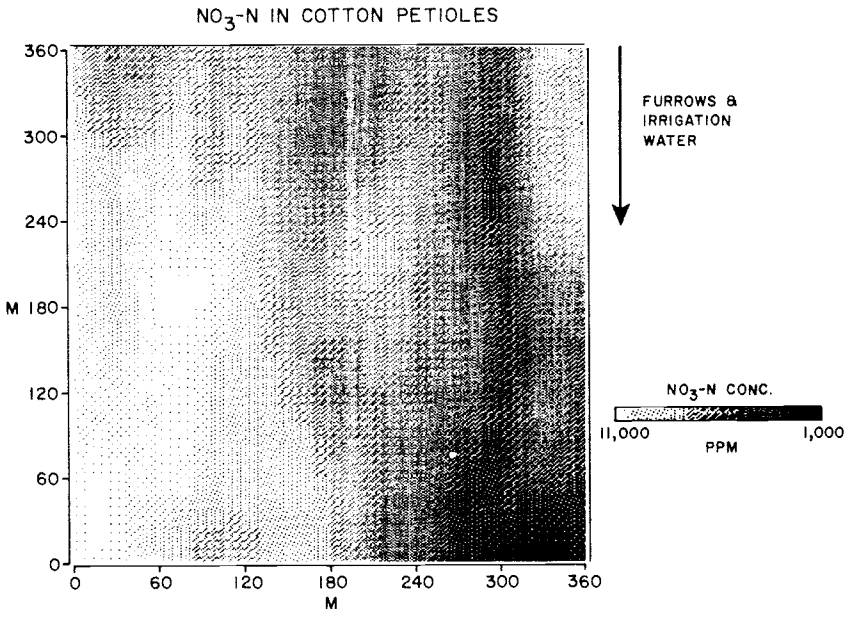

Figure 1. Kriged Map of nitrate concentrations for 32 acre field (coordinates are in meters)

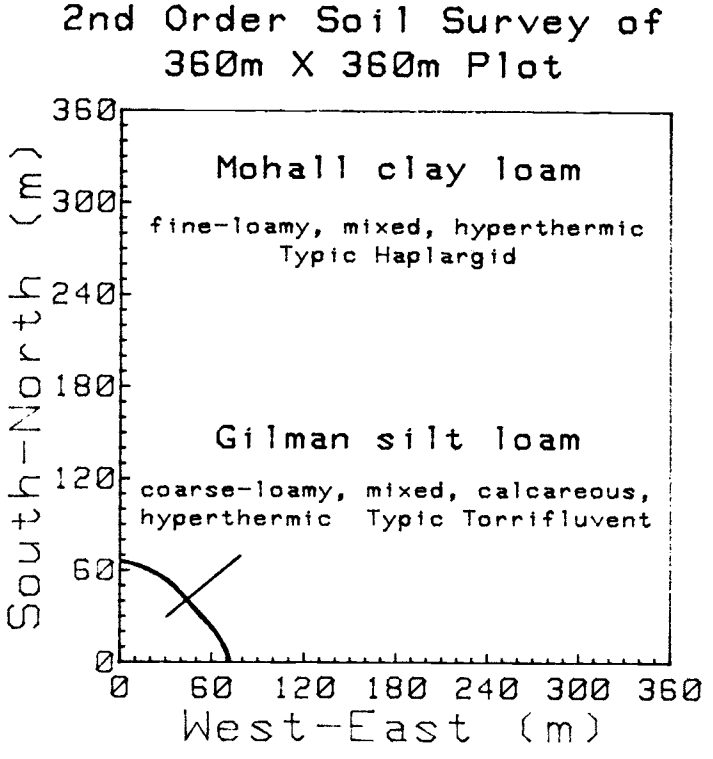

Figure 2. Intensive soils map of 32 acre field (coordinates are in meters)