Mapping Field Soil Fertility Levels With Sampling Grids, Topography and Yield Monitor Data

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INTRODUCTION

Patterns of yellow and green across sugarbeet fields at harvest suggest that field nitrate-N levels are variable. N levels influence yield and quality in sugarbeet. One of the goals of precision farming in sugarbeet production should be to identify field nitrate-N levels in a cost-effective manner in order to maximize yield and sugar production. Grid sampling for P, K and pH in some areas of the United States has shown that about one sample per acre may be required to adequately identify some fertility boundaries (Wollenhaupt, et al., 1994, Franzen and Peck, 1995). In the Red River Valley, initial commercial adoption of a 4-5 acre grid for nitrate-N levels was based on cost considerations. Early investigations in North Dakota west of the Valley area suggested that there may be relationships between landscape and fertility levels. These studies were initiated to determine what levels or methods of sampling might be appropriate to direct variable-rate nutrient application based on agronomic considerations.

MATERIALS AND METHODS

In North Dakota, two forty acre Red River Valley fields were sampled in a 110 ft. grid. One site is located southwest of Gardner, ND, and the other site is located south of Colfax, ND. Each sample location consisted of at least five soil cores taken at 0-6 inch and 6-24 inch depth. Sample cores were also taken at a 24-48 inch depth. Elevation was measured using a laser surveying device in a 110 ft. grid. Elevation was measured to the nearest tenth inch. Elevation and soil fertility levels were mapped using inverse distance squared interpolation through Surfer (Golden Software Co., Golden CO). Sampling grids of 220 ft., 330 ft., and a 5 acre grid were compared to the original sampling by comparing the estimated values at each 110 ft. sampling location with the 110 ft. sampled values. Points common to each comparison were excluded from the correlation procedure to avoid autocorrelation. Topography sampling was simulated by selecting landscape zones within each field, and then selecting a sample value to represent the landscape zone. The landscape zone estimate of each of the 110 ft. sample locations was compared to the 110 ft. sampled values.

Although not used in these two study fields, yield monitors were used at two locations similarly sampled outside of the Valley. Yield monitor data indicated at each field an area of reduced yield. By selecting that area as another sampling zone, correlation of sampling zone by landscape with the original sample values was increased.

In Minnesota, two fields were selected for study near Crookston, MN. Elevation was determined and mapped. Soil nitrate-N levels were compared to landscape.

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RESULTS AND DISCUSSION

At Colfax, topography sampling for P was as correlated as a 5 acre grid, while a 220 foot and 330 foot grid was superior topography (Table 1). At Gardner, topography sampling was better correlated with the 110 ft. grid than the 330 ft. grid sampling, but not as highly as the 220 foot or 5 acre grids.

Table 1. Correlation of P levels with selected sampling grids and topography sampling with the 110 foot sampled locations.

Site	Topography	220 ft. grid	330 ft. grid	5 acre grid
Colfax	0.16	0.62	0.37	0.17
Gardner	0.40	0.44	0.34	0.56

At Colfax, topography sampling for nitrate-N was better correlated with the 110 foot grid than the 5 acre grid (Table 2). At Gardner, topography sampling for nitrate-N was better correlated with the 110 foot sampling grid than the 330 foot or the 5 acre grid. The 220 foot grid was only slightly better correlated than topography sampling. Topography sampling at Colfax was based on five sample points. At Gardner, topography sampling was based on seven points.

Table 2. Correlation of nitrate-N levels with selected sampling grids and topography sampling with the 110 foot sampled locations.

Site	Topography	220 ft. grid	330 ft. grid	5 acre grid
Colfax	0.32	0.62	0.45	0.06
Gardner	0.31	0.39	0.23	0.04

In related studies outside of the Valley, yield monitor data was useful in determining additional sampling zones not identified by the elevation sampling. Large differences in yield within an identified sampling zone could suggest that the zone should be further subdivided with additional sampling.

In the Minnesota studies, in a field characterized by multiple landscapes of rises, slopes and depressional areas, there were differences in nitrate-N levels due to landscape (Table 3).

Table 3. Nitrate-N levels, lb/acre 4 feet, in a Minnesota field based on landscape structure.

High	Slopes	Depressions
152	78	24

In another Minnesota field characterized by having a long slope, containing no hilltops or depressional areas, there was not a relationship to elevation. These Minnesota studies suggest that correlation of nutrient levels is not with elevation, but with the structure (hilltops, slopes and depressional areas) mapped with elevation data.

Future research will investigate landscape and grid sampling density sampling over the course of a sugarbeet rotation, and additional methods to identify and characterize sampling zones. Topography sampling, if shown to be consistently correlated with field nutrient levels, may result in increased definition of nutrient level boundaries while decreasing associated sampling costs.

REFERENCE

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