Key properties for delineating soil management zones

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I. Starting point

It was concluded that in the loess area, with complex soil-landscape interactions, pH, EC, and elevation can be defined as the key properties to delineate potential management classes for precision agriculture.

II. The study area

IV. The data set

1. Elevation

Scanned by LIDAR: 0.07 m vertical accuracy.
1 variable: DEM.
2. Soil samples

30 locations randomly selected out of 100 stratified random samples.
- 2 depths: 0-0.3 m + 0.6-0.9 m.
- 6 variables: top and subsoil OC, sand & pH-KCl.

3. ECa (EMI-sensor)

EM38-MK2: measured at 2 m inter-line distance.
4 ECa variables: 0.5 and 1 m, both H and V orient.

4. Gamma ray (The Mole)

Natural radionuclides in top 30 cm. Measured at 30 locations + along lines over entire field.
4 variables: ^{40}K, ^{238}U, ^{137}Cs and ^{232}Th.

5. Identification of key properties

30 locations, 15 variables: principal component analysis on correlation matrix.
First 3 PC’s covered 72.5 %, variables with largest loadings were selected.

VI. Management zones

1. Maps

- No of classes
- Performance index

2. Fuzzy k-means classification of 3 key properties
VII. Wheat yield

1. Yield of 2006

Continuous wheat grain recorded with New Holland CX880 combine in summer 2006.

Processing: ref. moisture content (15 %) + data filtering.

2. Yield & management classes

Yield of 2006:
- 9.9 t/ha (s = 0.54)
- 8.6 t/ha (s = 0.57)
- 8.8 t/ha (s = 0.71)

3. Relationship between yield and key properties

Stepwise multiple regression analysis:

\[ \text{Yield}_{2006} = -0.324 + (0.175 \times \text{ECa}^{0.5}) + (1.009 \times \text{DEM}) - (0.00217 \times \text{ECa}^{1.5}) \]

\[ R^2 = 0.88 \]

pH did not influence wheat yield of 2006 significantly; ECa was dominant.

4. Boundary line analysis between ECa and yield

Select top 10 % of yield within moving ECa bins of 3 mS/m: locations where ECa is limiting yield.

\[ \text{Yield}_{2006} = 6.537 + (0.232 \times \text{ECa}^{0.5}) - (0.00331 \times \text{ECa}^{1.5}) \]

\[ R^2 = 0.98 \]

VIII. Conclusions

- Candidate key soil properties for management zone delineation in wind blown sediments of Northern-Europe:
  - ECa, elevation and topsoil pH.

- These properties allow to construct relatively stable management zones which produce clear differences in crop yield.

- ECa relates very strongly to wheat yield.