In-Field Zone Management of Field Crops

Introduction

Precision agriculture is a management strategy to optimize and economize resources (fertilizer, manure, seed, etc.) in specific areas within fields (called management zones) to reduce inefficiencies associated with average-based whole field management. Management zones share similar characteristics. They can be mapped based on any number of measurable field characteristics, but yield, yield stability over time, and soil fertility indicators are commonly used. This factsheet provides information on the benefits of zone-based management, field characteristics that may be used to create management zone maps, and the importance of data collection for zone creation and mapping.

Benefits

Managing a whole field with one application rate based on average field values will always result in over or under-application in certain areas of the field. Zone-based management can lead to improved efficiency and economy of resources, and possibly result in higher crop yields and increased crop quality. In addition, once zones are established within fields, crop needs can be evaluated per zone. Furthermore, zones can highlight field characteristics that might indicate the need for change in large-scale management practices such as crop selection, land use, or increased drainage, or smaller-scale practices like variety selection, seeding rates, and lime, manure, or fertilizer applications. At its most basic level, tailoring management to specific field characteristics may not need precision agriculture equipment (i.e. changing management in visible wet spots). However, with modern field equipment and software it is now feasible to program field equipment based on farm specific, within-field, management zones (Figure 1).

Importance of Data

Yield data are a primary basis for zone-based management and evaluation. When available, several years of yield data can be used to develop reliable yield stability zones. Before yield-based management zones can be created, the yield data from combine- or chopper-mounted yield monitors must be cleaned to remove operator errors and adjust for equipment and sensor limitations (see Agronomy Fact Sheet #107). In addition to yield data, characteristics of the landscape and soil can be used to derive management zones.

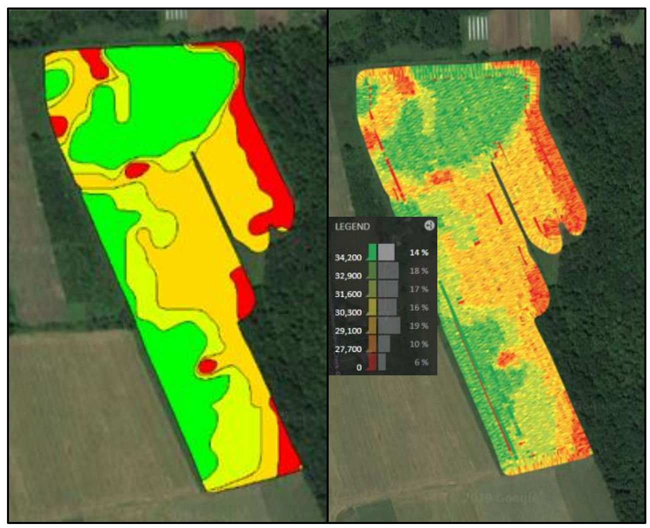

Figure 1. Yield stability zones defined using SMS Ag Leader (left) and variable rate seeding based on the zones (right).

Equipment and Tools

There are several tools and technologies that make zone-based management possible.

- Global positioning system (GPS) receiver: indicates specific locations within the field.
- Yield monitor: captures forage or grain flow across a sensor at a specific location.
- Moisture sensor: estimates moisture content of the crop as it passes the sensor.
- Soil/nutrient testing: basic test packages include soil organic matter, pH, buffer pH, extractable phosphorus, potassium, calcium, magnesium, and micronutrients. Additional specific nutrient tests such as soil nitrate or sulfur may be added when relevant.
- Data management software such as *SMS Ag Leader* are used to compile and layer

georeferenced harvest and sample data to map zones based on field characteristics.

Zone Development

Characteristics used to map management zones can be divided into three categories. The first is visible/existing physical characteristics that persist over several years (e.g. soil type, texture, slope, or elevation). The second category includes measurable characteristics: properties that may change over time and must be measured or assessed annually or every few growing seasons (such as soil fertility, organic matter, and electrical conductivity). These characteristics are more challenging to base zones on as they can change over time or from season-to-season. In addition, measuring these characteristics may require special equipment and may involve intensive sampling and additional laboratory costs to obtain accurate data. The third category relates to past yield achievements. Historical yield data (3 years or more) can be used to derive yield stability zones that combine average yield and yield variability over time to determine zones (Figure 2).

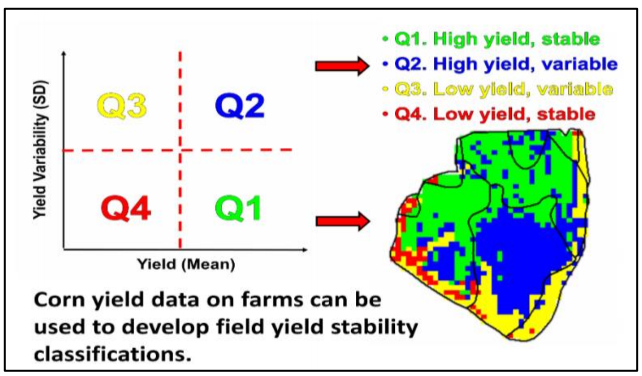

Figure 2. Using at least three years of historical yield data, yield stability zones can be created using whole-farm average crop yield and standard deviation of crop yield over time to create management zones.

An important additional benefit of zone-delineation is that it can help with on-farm research. Due to the variable nature of crop responses to management practices, test plots may be placed across management zones to test available options before large-scale changes are made. Georeferenced yield monitor data of the test plots can help a farmer determine if the management change is an improvement over current practices.

Zone Aggregation and Management

The number and size of management zones within a field is a function of variability but can also be determined by pragmatic management considerations. Grouping several smaller areas with similar characteristics into one larger zone within a field may be needed to be practical. Farmer feedback suggests that four zones per field is manageable, although some may choose to manage a greater number of zones. Zone-based management can vary in intensity and precision (number and size of zones, variable rates applied, etc.), depending on available equipment and application technology, practical capabilities, and the farm's production goals. A farmer or farm consultant can digitally map zones based on layered sets of georeferenced data, and then program field prescriptions into application equipment.

General Summary

Segregating fields into smaller management zones based on common characteristic can lead to more targeted and efficient use of resources. Zone management is an effective tool in precision agriculture to optimize yields while using acceptable resource inputs.

Additional Resources

- Chang, J., C.L. Reese, T. Kharel, S.A. Clay, and D.E. Clay. 2016. Precision Farming Opportunities**.** Chapter 19**.** In: Clay, D.E., C.G. Carlson, S.A. Clay, and E. Byamukama (editors). iGROW Corn: Best Management Practices. South Dakota State University. https://extension.sdstate.edu/sites/default/files/2019-09/S-0003-19-Corn.pdf
- Cornell University Nutrient Management Spear Program (NMSP) Agronomy Factsheet Series: https://nmsp.cals.cornell.edu/guidelines/factsheets.html

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For more information

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