
Management Zones I - Role in Site-Specific Management

Introduction

Site-specific management (SSM) is a potential strategy towards sustainable agriculture. This strategy allows one to better match crop requirements according to site-specific yield potential rather than averaging input requirements for the whole field. However, it is necessary to assess the degree of within-field variability before deciding to implement any type of SSM. Several approaches are used to identify and measure field spatial variability. The identification of areas or management zones (MZ) within a field with differences in soil properties, plant growth and yield, pests, and diseases allows farmers to implement the right management at the right place, with the right implement and at the right time.

What are Management Zones?

Management Zones (MZ) are sub-regions within a field with different characteristics (e.g., soil fertility levels, elevation, slope, soil texture, water holding capacity, pest population density). *Each zone, having a specific yield potential, should represent an area with a homogeneous combination of factors/characteristics for which a specific practice and/or single rate of an agricultural input is required.* Therefore, MZ delineation can be defined as a method of classifying within-field spatial variability. MZ are usually generated from a single data layer, or a combination of data layers including yield monitor data, soil survey maps, soil fertility maps, or data collected from on-the-go remote sensors assessing crop growth variability. The resulting MZ map can be used by the farmer as a guide to decide which production and conservation strategies are needed and where they should be placed.

Uses and benefits of Site-Specific Management Zones

Most of the economic, agronomic and environmental benefits of MZ delineation are related to the variable rate application (VRA) of inputs. Based on different levels of soil fertility, water holding capacity, and/or risk for pest or diseases, the amount of one particular input or other management practice can be adjusted by zone to match the within-zone requirements. This can result in increased efficiency, and in some cases, increased profitability while minimizing potential environmental risks. The elevated prices of inputs are another justification for utilizing zone management.

Adjusting input rates on-the-go while traversing a field requires a GPS receiver to provide position information, a variable-rate controller which has the ability to vary product rates and a “*prescription map*” which communicates to the controller the appropriate rate. Prescription maps are often based on MZ maps. For example seeding rates (high, medium, and low rates) can be assigned to corresponding field management zones that have been classified as high, medium or low yielding areas. Variable rate application can be implemented for fertilizers (e.g., nitrogen, phosphorus, potassium, and micronutrients), herbicides,

nematicides, seeding, water and tillage. In addition, different crop varieties can be planted according to the MZ yield potential.

Directed sampling is another advantage of MZ delineation. Traditionally, farmers have relied on whole-field sampling to assess fertility levels. However, this sampling approach does not always accurately represent spatial variation in fertility levels. In contrast, regularly-spaced grid soil sampling provides data that better characterizes the variability of soil nutrients, however; this is an expensive and time-consuming approach. An alternative method for sampling uses MZ, which can provide producers a soil sampling scheme based on intrinsic soil properties and yield potential. For example, a farmer could collect and composite soil samples from each zone, and send a composite soil sample by zone to a soil testing laboratory for analysis. This scheme allows soil fertility levels to be linked to the location of each zone through its geographic location, and subsequently, fertilizer and lime applications could be adjusted according to site-specific fertility levels.

Several on-farm research studies have shown that it is economically feasible to implement a site-specific management by zones. In Texas for example, the VRA of nitrogen by MZ delineated from elevation and terrain slope data resulted in higher cotton yields and higher net returns compared to the uniform rate application. In Georgia, the VRA of nematicides resulted in higher cotton yields, lower southern root-knot nematode population and higher net returns on the zones with a high risk for high nematode populations (coarse sand texture). In Colorado, the VRA of nitrogen in corn resulted in less total fertilizer (6-46%) applied compared to a uniform N management. Net returns ranged from \$7.37 to \$11.97 acre higher than returns with uniform N management. In Nebraska, studies during 2004-2005 by the University of Nebraska showed savings of \$9.54 per acre when using site specific nitrogen application and zone management. Saving increased up to \$26.,38 per acre when the study was repeated in 2008. These examples evidence some of the economic benefits of VRA and zone management.

The potential benefits of a management by zones approach might be linked to intrinsic within-field variability and the techniques used to delineate the zones. Then, management zones delineation can be unique to each farm, even to each field, and there is no right or wrong way to identify management zones. However, the process can evolve based on results and additional data can be collected over time.

Note: For more information on directed soil sampling, reference the Timely Information sheet: Precision Soil Sampling for Alabama Farms and for more information about creation of variable-rate prescription maps, please reference the Timely Info sheet: Introduction to Prescription Maps for Variable-Rate Application.

Disclaimer

The mention of trade names and commercial products is for informational purposes and does not necessarily imply endorsement by the Alabama Cooperative Extension System.

Prepared by

Brenda V. Ortiz, *Assistant Professor and Extension Specialist*, Joey Shaw, *Alumni Professor*, and John P Fulton, *Associate Professor and Extension Specialist*, Amy Winstead, *Regional Extension Agent*, Alabama Cooperative Extension System.

www.AlabamaPrecisionAgOnline.com