EVALUATION OF YIELD MAPS USING FUZZY INDICATORS

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ABSTRACT

This paper presents a new methodology for the evaluation of yield maps using fuzzy indicators, which takes into account atypical phenomena and expert opinions regarding the maps. This methodology could allow for improved methods for deciding boundary locations for precision application of production resources.

INTRODUCTION

The ultimate goal of application of yield maps is to develop profitable cropping systems. Yield maps are the starting point in the precision farming system, and provide the final record indicating the effectiveness of any management changes. However, yield mapping many time indicate that the zones with different levels of yield changes drastically from year to year. Recently several methods have been developed to generalize multiple years of yield mapping. However, the applications of these methods are often troublesome when accounting for external variance in weather effects or variability of observations of any location in the field from one year to another.

This paper presents a new methodology for evaluation of yield maps using fuzzy indicators, which takes into account atypical phenomena and expert opinions. For evaluation of yield maps, we developed two general types of fuzzy indicators (FI): a) the individual fuzzy indicators (IFI), and b) the combined fuzzy indicators (CFI) (Krueger-Shvetsova and Kurtener, 2003).

IFI is defined as a number in the range from 0 to 1, which reflects an expert concept and is modeled by an appropriate membership function. The expert concept has to take into account the specifics of *j* area characterized level of yield, and *i* year of yield measurement. For example, agricultural land could be divided into three zones according to yield levels of poor, moderate, and best. The choice of a membership function is somewhat arbitrary and should mirror the subjective expert concept. The CFI is defined using fuzzy aggregated operations. By CFI it is possible to make an integrated estimation for long-term observations. The methodology was applied to the evaluation of yield maps obtained during a field experiment which was carried out in Bell County, TX (Torbert et al., 2000). The corn yield was monitored with a corn harvester for the three years of the study. In this case, the agricultural field was divided into three zones according to the levels of yield: poor, moderate, and best. Figure 1a – 1c shows that the position for yield boundaries of these zones changed dramatically from year to year. On the basis of the methodology, we developed a computer program using Matlab. This computer program provided a method to obtain an integrated estimation for long-term observations. Figure 1d shows a map of CFI, which generalized data for the three years of the study.

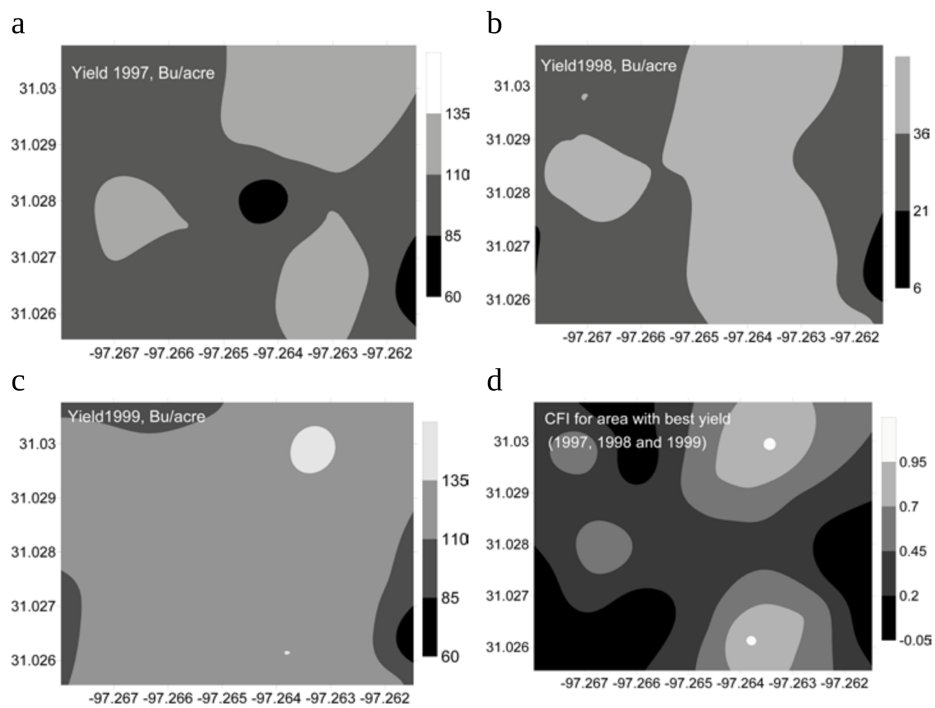

Fig. 1. Yield maps based on data of 1997 (a), 1998 (b), 1999 (c), and map of CFI generalized data for the three years of the study.

The results indicate that the use of fuzzy indicators can be a viable method to evaluate yield maps over multiple years to improved boundary designations.

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