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The yield pattern considering the distance to flow accumulation lines

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Abstract

Precision agriculture techniques imply a spatial management of fields and to do so a good understanding of the spatial and temporal variability of yield is needed. Average yield data from seven irrigated maize fields were used to study the yield pattern considering the distance of plants to flow accumulation lines. It was found that there is a significant correlation between average yield and distance to flow accumulation lines (DFL). This correlation is best represented by a polynomial function. The most common shape of the yield pattern curve considering the distance to flow accumulation lines shows that there is an increase in average yield with DFL from 0 to 12.5–17.5 m. Near the flow lines the average yield presents lower values due to drainage problems causing plant growth problems. It was also observed higher yield variability near the flow lines. For higher distances from the flow lines there is a continuous decrease in average yield due to less water availability and other variations of soil properties.

Keywords: Distance to flow lines; Yield variability; Yield pattern; Irrigated maize

1. Introduction

In a recent past spatial and temporal analyses of yield variability was considered very important in order to delineate areas of stable yield patterns for application of precision farming techniques (Bakhsh et al., 2000). More recently, several authors have found that most spatial variability disappears over time if we consider the average productivity map, consequently yield maps cannot forecast the yield pattern for the following year and crops should be managed in accordance with their needs in real time (Blackmore et al., 2003; Marques da Silva, 2006).

However, there are some permanent spatial factors of fields that can be correlated with yield allowing a better understanding of yield variability. Topography has been considered one of the most important yield-affecting factors (Changere and Lal, 1997; McConkey et al., 1997), and most topographic attributes are permanent spatial factors. Topographic attributes or indices can be derived from digital elevation models (DEMs), which can provide important topographic information with increased accuracy (Moore et al., 1993; Wilson et al., 1998). The relationship between topographic attributes and yield has been extensively used to evaluate yield variability. It is possible to find in the literature several studies analysing the relationship between topographic attributes and yield variability (e.g., Bakhsh et al., 2000; Kravchenko and Bullock, 2000; Kaspar et al., 2003; Iqbal et al., 2005). Marques da Silva and Silva (submitted for publication) studied the relationship between several topographic attributes and irrigated maize spatial and temporal variability. They found that the distance to flow accumulation lines was the topographic index with higher correlation with yield. Previous studies (Marques da Silva and Silva, 2006a,b) showed a significant relationship between irrigated maize yield and DFL, indicating that, in undulated topographies, the DFL index could be a useful parameter to explain yield variability. The higher soil depth and higher soil water content near flow accumulation lines can explain the increase of yield with the decrease of DFL (Marques da Silva and Silva, 2006a,b).

Plant available soil water has been considered by many authors as the major factor contributing to yield variability (Sinai et al., 1981; Sadler et al., 1995; Wright et al., 1990; Camp and Sadler, 2002), and the amount of water retained by a soil is greatly determined by landscape position (Hanna et al., 1982). Lower landscape positions, to where flow accumulation lines converge have usually higher soil water contents, thus more plant available water and hence more nutrients.

The objective of this study was to observe the variability of irrigated maize (*Zea mays* L.) yield pattern considering the distance to flow accumulation lines. The understanding of the

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