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Evaluation of Maize Yield Spatial Variability based on Field Flow Density

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Abstract

Maize yield is affected by water availability, which varies with field topography. The analysis of yield data obtained in different field landscape positions allows the spatial patterns of crop yield to be identified and related to field attributes, helping the spatial management of fields to be improved. The relationship between distance to flow accumulation lines (DFL) and spatial variability of yield and grain moisture at harvest has already been identified in a previous work by the authors. The main objective of this study is to confirm the relationship between DFL and spatial variability of yield and grain moisture at harvest, and also to establish a relationship between a field hydrological attribute (flow density) and average yield and distance to nearest flow accumulation line. The study was conducted using data collected from three agricultural fields (30,40 and 60 ha) irrigated by centre-pivot systems, in Southern Portugal, over a 3 yr period from 2002 to 2004.Collected data were divided into data sets corresponding to nine classes of DFL. Total flow lines length (SFLL) was used to calculate flow density (Fd). Based on these data sets, the relationship between yield and grain moisture at harvest and DFL and flow density was analysed. Coefficients of determination were very high (significant R2 from 0.91 to 0.98) for almost every year of the experiment, indicating that average yield and average grain moisture content at harvest are significantly related to the DFL. In all three years and for all centre-pivot systems, average yield decreases as DFL increases. Yield spatial variability was high, with coefficients of variation ranging from 22 9%to 42 8%, and the lowest values were obtained in the year with the greatest amount of applied water (2004), confirming the importance of plant water availability in yield. Generally, average grain moisture content also shows a decrease with an increase in DFL. Inter-year grain moisture at harvest offset is higher than the inter-year yield offset, which is mainly caused by differences in the harvesting date and the grain maturation stage at harvest. The slope of the linear regression between average yield and DFL can be used as a parameter to estimate yield dependence on flow accumulation lines within a centre-pivot-irrigated field. Greater slopes indicate a greater effect of DFL on yield. This regression

coefficient was correlated with flow density showing a strong relationship. This allows the regression coefficient to be derived using flow density values.