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Spatial variability of soil carbon, pH, available phosphorous and potassium in organic farm located in Mediterranean Croatia

Igor Bogunović, Paulo Pereira, and Miranda Šeput

University of Zagreb, Faculty of Agriculture, Department of General Agronomy, Zagreb, Croatia (igor.bogunovic@gmail.com)

Soil organic carbon (SOC), pH, available phosphorus (P), and potassium (K) are some of the most important factors to soil fertility. These soil parameters are highly variable in space and time, with implications to crop production. The aim of this work is study the spatial variability of SOC, pH, P and K in an organic farm located in river Rasa valley (Croatia). A regular grid (100 x 100 m) was designed and 182 samples were collected on Silty Clay Loam soil. P, K and SOC showed moderate heterogeneity with coefficient of variation (CV) of 21.6%, 32.8% and 51.9%, respectively. Soil pH record low spatial variability with CV of 1.5%. Soil pH, P and SOC did not follow normal distribution. Only after a Box-Cox transformation, data respected the normality requirements. Directional exponential models were the best fitted and used to describe spatial autocorrelation. Soil pH, P and SOC showed strong spatial dependence with nugget to sill ratio with 13.78%, 0.00% and 20.29%, respectively. Only K recorded moderate spatial dependence. Semivariogram ranges indicate that future sampling interval could be 150 - 200 m in order to reduce sampling costs. Fourteen different interpolation models for mapping soil properties were tested. The method with lowest Root Mean Square Error was the most appropriated to map the variable. The results showed that radial basis function models (Spline with Tension and Completely Regularized Spline) for P and K were the best predictors, while Thin Plate Spline and inverse distance weighting models were the least accurate. The best interpolator for pH and SOC was the local polynomial with the power of 1, while the least accurate were Thin Plate Spline. According to soil nutrient maps investigated area record very rich supply with K while P supply was insufficient on largest part of area. Soil pH maps showed mostly neutral reaction while individual parts of alkaline soil indicate the possibility of penetration of seawater and salt accumulation in the soil profile. Future research should focus on spatial patterns on soil pH, electrical conductivity and sodium adsorption ratio.

Keywords: geostatistics, semivariogram, interpolation models, soil chemical properties