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Spatial distribution of cereal yields related to the application of soil-improving cropping systems (SICS)

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Research indicates that spatial differentiation of crop yields and soil properties are largely influenced by agricultural practices and the nature of the soil itself. The aim of this study was to examine the spatial relationship between cereal (wheat and oats) yields and soil properties related to the application of soil-improving cropping systems (SICS). Four-year experiment (2017-2020) was carried out on low productive sandy soil with application of following SICS: S1 – control; S2 – liming; S3 – green manure/cover crops including lupine, phacelia, serradella; S4 – manure and S5 – manure, liming and cover crops together. Effect of the SICS was evaluated using classical statistics, Bland-Altman analysis and geostatistical methods. Mathematical functions, fitted to the experimental cross- and semivariograms were used for mapping the yields (grain and straw) by ordinary cokriging. The grain yields in years with normal rainfall increased by 2% for S2, 10% for S3, 46% for S4, 47% for S5 compared to control (S1) 2789 kg/ha and in dry years were lower (respectively for S2-S5 by 16.3, 10.6, 2.8, 9.9% compared to control 1567 kg/ha. The range of spatial dependence for the yields in direct semi-variograms varied was 50–100 m and > 100 m in cross-semivariograms using textural fractions as secondary variables. The spatial relationships were stronger between yield and soil texture and properties were much stronger with texture and cation exchange capacity than with pH and organic carbon content. Using cokriging for interpolation (mapping) allowed the delineation of zones of lower and higher cereal yields including areas of the SICS application. Higher cereal yield and lower spatial variability in the areas of SICS compared to control soil were observed in the years with normal rainfall. Analysis of the Bland-Altman including limits of agreement enabled to quantify the effect of particular SICS on cereal yield vs. control reference. Different effect of particular SICS on the cereal yield was observed in the years with scarce and good rainfall amount and distribution during growing season. The greatest variation of the cereal yield was observed in manure amended soil (S4) and it was lower and similar in the areas of remaining SICS (S2-S5). The results will help to to select most effective SICS for localized improving crop productivity and adaptation to global warming.

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