
Spatial analyses in environmental studies: In-field variation of soil phosphorus in small farms in Ireland

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Abstract

The rapid applications of new information and communications technology (ICT) in agriculture have new opportunities for the precision applications of fertilisers, requiring the information of in-field variation of soil nutrients in farms. Such information does not exist for most of the farms, especially those of small sizes. The current nutrient management in Ireland is based on soil analyses for composite samples, with each of them representing an area of several hectares, which has ignored the in-field variation of nutrient demand at the farmland level. One of the available datasets in Ireland is the national soil database contained a total of 1310 soil samples at the density of 2 samples every 10*10 km grid. While the total concentrations of phosphorus (P) demonstrated good spatial patterns which were mainly related to geology (e.g., relatively high values in sandstone areas and low values in limestone areas), the plant available fractions of P showed poor spatial patterns at the national level, with a poor spatial structure revealed by the variogram in geostatistics, implying the strong influences of agricultural activities. Intensive soil sampling at the farmland level has revealed strong spatial variations of available P and other nutrients at the in-field level, with nutrient index advice level ranging from the lowest to the highest. These results provide strong challenges to the current composite sampling strategy in Ireland and elsewhere. It is recommended that even in small farmland in Ireland, more precise in-field variation of available P should be better quantified and such information can be useful to improve the current nutrient management.

Keywords: In-field variation; Small scale; Nutrient management; Geostatistics