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Assessing the spatial distribution of glyphosate-AMPA in an Argentinian farm field using a pedometric technique

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The cultivation of transgenic glyphosate-resistant crops has been the most rapidly adopted crop technology in Argentina since 1997. Thus, more than 180 million liters of the broad-spectrum herbicide glyphosate (N – phosphonomethylglicine) are applied every year. The intensive use of glyphosate combined with geomorphometrical characteristics of the Pampa region is a matter of environmental concern. An integral component of assessing the risk of soil contamination in farm fields is to describe the spatial distribution of the levels of contaminant agent. Application of pedometric techniques for this purpose has been scarcely demonstrated. These techniques could provide an estimate of the concentration at a given unsampled location, as well as the probability that concentration will exceed the critical threshold concentration. In this work, a pedometric technique for assessing the spatial distribution of glyphosate in farm fields was developed. A field located at INTA Barrow, Argentina (Lat: -38.322844, Lon: -60.25572) which has a great soil spatial variability, was divided by soil-specific zones using a pedometric technique. This was developed integrating INTA Soil Survey information and a digital elevation model (DEM) obtained from a DGPS. Firstly, 10 topographic indices derived from a DEM were computed in a Random Forest algorithm to obtain a classification model for soil map units (SMU). Secondly, a classification model was applied to those topographic indices but at a scale higher than 1:1000. Finally, a spatial principal component analysis and a clustering using Fuzzy K-means were used into each SMU. From this clustering, three soil-specific zones were determined which were also validated through apparent electrical conductivity (CEa) measurements. Three soil sample points were determined by zone. In each one, samples from 0-10, 10-20 and 20-40cm depth were taken. Glyphosate content and AMPA in each soil sample were analyzed using de UPLC-MS/MS ESI (+/-). Only AMPA at 10-20 cm depth had significant difference among soil-specific zones. However, marked trends for glyphosate content and AMPA were clearly shown among zones. These results suggest that (i) the presence of glyphosate and AMPA has spatial patterns distribution related to soil properties at field scale; and (ii) the proposed technique allowed to determine soil-specific zones related to the spatial distribution of glyphosate and AMPA fast, cost-effective and accurately. In further works, we would suggest adding new soil information sources to improve soil-specific zone delimitation.