Data Article

Site-specific data on herbicide soil retention and ancillary environmental variables

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ABSTRACT

This article presents original geospatial data on soil adsorption coefficient (Kd) for two widely used herbicides in agriculture, glyphosate and atrazine. Besides Kds, the dataset includes site-specific soil data: pH, total nitrogen, total organic carbon, Na, K, Ca, Mg, Zn, Mn, Cu, cation exchange capacity, percentage of sand, silt and clay, water holding capacity, aluminum and iron oxides, as well as climatic and topographic variables. The quantification of herbicides soil retention was made on a sample of soils selected by Conditionated Latin Hypercube method to capture the underlying edaphoclimatic variability in Córdoba, Argentina. The glyphosate data presented here has been used to evaluate statistical methods for model-based digital mapping (F. Giannini Kurina, S. Hang, R. Macchiavelli, M. Balzarini, 2019) [1]. The dataset is made publicly available to enable future analyzes on processes that leads the dynamics of both herbicides in soil.

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1. Data

Data have been cataloged for Kd of glyphosate (n = 89 sites) and atrazine (n = 156) found in soil. The Kd coefficient parametrizes the herbicide retention process. It expresses the relationship between the concentrations of the agrochemical between the solid phase and the solution of soil. Data also included environmental variables (edaphic, topographic and climatic) for a total of 355 geo-referenced sites (Fig. 1), from which soil sample were collected. Measured soil variables were pH, Total Nitrogen, Soil Organic Carbon, Na, K, Ca, Mg, Zn, Mn, Cu, Cation Exchange Capacity, percentage of Sand, Silt and Clay, water holding capacity, and aluminum and iron oxides [2]. Topographic (Elevation) and climatic data (annual cumulative precipitation and mean annual air temperature) were extracted from open global databases [3,4]. Attributes of the database are described in Table 1. The dataset table is provided as an Excel file (Microsoft Corporation, Redmond, Washington) and as an interactive map KML file (Keyhole Markup Language) in the supplementary material. The glyphosate data presented here has been used to evaluate statistical methods for model-based digital mapping (F. Giannini Kurina, S. Hang, R. Macchiavelli, M. Balzarini, 2019) [1].

2. Experimental design, materials and methods

Soil samples were taken from the upper 15 cm of soil in a regular 40 × 40 km grid (Fig. 1). Soil properties were measured according with the methods listed in Table 1. Topographic variables were obtained from the Digital Elevation Model provided by the STRM (Shuttle Radar Topography Mission [3]) and climatic information, taken from the global database of climatic analysis (BIOCLIM [4]). Using Conditioned Latin Hypercube [10] method a sample of 89 sites was obtained to determine glyphosate retention and another sample 159 sites to quantify atrazine retention. For both herbicides, the Kd coefficient were determined in each soil sample according to the batch-equilibrium technique for the preparation of soil suspensions. For fortifications, the standards had a >98% of purity and were provided by Sigma-Aldrich standards. A 2g soil mass was put in 50 ml centrifuge tubes where 10 ml of the fortification solution (concentrations of 10 mgL−1 for glyphosate and 20 mgL−1 for atrazine) were
Fig. 1. Cordoba, Argentina (29°–35°S, and 61° to 65°W). Sample sites.

Table 1
Herbicides adsorption coefficients and environmental variables in spatialized sites. Cordoba, Argentina.

| Variable       | Units       | Description                                                                 |
|----------------|-------------|------------------------------------------------------------------------------|
| ID_2           | –           | Identification code                                                          |
| X UTM20        | m           | Universal transverse mercator, zone 20 South coordinates reference system     |
| Y UTM20        | m           | Universal transverse mercator, zone 20 South coordinates reference system     |
| pH             | –           | pH in water 1:2.5 (soil:water)                                               |
| EC             | dS m⁻¹      | Electrical conductivity in water 1:2.5 (soil:water)                           |
| SOC            | g kg⁻¹      | Soil organic carbon by 1 N K₂Cr₂O₇ wet combustion, Walkley and Black method [5] |
| TN             | % p:p       | Total Nitrogen, Kjeldahl method [5]                                           |
| Mn             | mg kg⁻¹     | Extractable Manganese, extraction by Mehlic-3 [6]                             |
| Cu             | mg kg⁻¹     | Extractable Copper, extraction by Mehlic-3 [6]                                |
| Zn             | mg kg⁻¹     | Extractable Zinc, extraction by Mehlic-3 [6]                                  |
| WHC            | %           | Water holding capacity, 300 kPa with a pressure cooker [7]                    |
| Silt           | %           | Sand content, Robinson pipette method [5]                                     |
| Lime           | %           | Lime content, Robinson pipette method [5]                                     |
| Clay           | %           | Clay content, Robinson pipette method [5]                                     |
| Al(Ox)         | %           | Aluminum oxides [8]                                                           |
| Fe(Ox)         | %           | Iron oxides [8]                                                               |
| P              | ppm         | Phosphorus extractable, extraction by the Bray and Kurtz 1, colorimetric [5]   |
| K              | Ppm         | Exchangeable Potassium (ppm), flame Photometry [5]                            |
| Ca             | ppm         | Exchangeable Calcium (ppm), complexometric [5]                                |
| Na             | ppm         | Exchangeable Sodium (ppm), flame Photometry [5]                               |
| Mg             | ppm         | Exchangeable Magness (ppm), complexometric [5]                                |
| CEC            | Cmol kg⁻¹   | Cation exchange capacity [5]                                                  |
| Elevation      | m.a.s.l     | Elevation, Digital Elevation Model STRM [3]                                  |
| Tm             | °C          | Mean air annual temperature, BIOCLIM [4]                                     |
| pp             | mm          | Annual cumulated precipitations, BIOCLIM [3]                                 |
| TvsPP          | °C mm⁻¹     | Tm over pp                                                                   |
| Kdg            | Lkg⁻¹       | Glyphosate adsorption coefficient                                             |
| Kda            | Lkg⁻¹       | Atrazine adsorption coefficient                                               |
| Kdg_measured   | –           | Sites with glyphosate Kd measured                                             |
| Kda_measured   | –           | Sites with atrazine Kd measured                                               |
| Zone (4)       | –           | Edaphoclimatic zoning [9]                                                    |
added. The fortified soils were first taken to a shaker for 24 h at 25 ± 1 °C, then centrifuged 5 min at 4000 rpm. Finally, the remaining supernatant was filtered by 0.45μm cellulose filters to a 1.5ml autosampler vials. The equilibrium concentration of each herbicide (Ceq) was quantified by high-pressure liquid chromatography (HPLC). For atrazine, a Photodiode Array Detectors (PDA) in a stationary phase octadecylesilane (C18) and for glyphosate post-column derivatization and fluorometric detection. The adsorbed concentration (Cad) was calculated as the difference between the initial concentration and the concentration at equilibrium in the solution. Finally, Kd was calculated as the following ratio Cad/Ceq. Variables in the built database are presented in Table 1.

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Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.dib.2019.104754.

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