



Glyphosate Dissipation in Different Soils Under No-Till and Conventional Till

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Glyphosate is the most used herbicide in Argentina, accounting for 62% of the commercialized pesticides in the market. It is used as a weed controller in chemical fallow under no-till systems, and it is also applied in various genetically modified crops (e.g. soybean, corn, cotton). Though it has a high solubility in water, it tends to adsorb and accumulate in agricultural soils. The description of glyphosate biodegradation in soils with a long term history under agricultural practices is of interest. The main objectives of this work were to compare the dissipation of glyphosate and the accumulation of its metabolite aminomethylphosphonic acid (AMPA) over time in three soils from Argentina. The studied soils belong to areas of high agronomic land use and different edaphoclimatic conditions, situated in Manfredi (MAN), Pergamino (PER) and Paraná (PAR). Soil samples were taken from long-term field trials with a history of more than 16 years under no-till and conventional tillage management. To study glyphosate dissipation in soil under controlled laboratory conditions, 400 g of dry soil sample were placed in 1.5 L flasks. A dose corresponding to 6 L ha⁻¹ of commercial glyphosate ATANOR II[®] (35.6 % a.i.) was applied on day 0. The dose applied was equivalent to a final concentration in soil of 4000 µg Kg⁻¹ of active ingredient. The moisture of the soil samples was kept at 60 % of the field capacity. Samples were incubated in the dark at a constant temperature of 22°C ± 1°C. A sub-sample of 5 g was taken from each flask at day 0 (after application), 1, 3, 7, 15, 20, 28, 44 and 62. Glyphosate and AMPA in soil samples was extracted with a strong basic solution (100 mM Na₂B₄O₇•10H₂O/ 100 mM K₃PO₄, pH=9) and then derivitized with FMOC-Cl. Detection and quantification of the compounds was performed by ultra-performance liquid chromatography coupled with a mass spectrometer (UPLC MS/MS). The results showed that forty percent of the applied glyphosate was degraded within the first three days in all soils, indicating a fast initial dissipation rate. However, the dissipation rate considerably decreased over time and the degradation kinetics adjusted to a two-compartment kinetic model. No differences were found between tillage practices. Dissipation was not related to the microbial activity measured as soil respiration. The fast decrease in the concentration of glyphosate at the beginning of the dissipation study was not reflected in an increase on the concentration of AMPA. The estimated half-lives for glyphosate ranged between 9 and 38 days. However, glyphosate bioavailability decreases over time as it is strongly adsorbed to the soil matrix. This increases its residence time which may lead to its accumulation in agricultural soils.