Effects of glyphosate application on soil chemistry to control invasive plants in a Mediterranean ecosystem

Jesús Jiménez-Ruiz [1,2 *], Juan Pablo del Monte [3] and María Inés Santín-Montanyá [4]

[1] Escuela Técnica Superior de Ingeniería Agronómica, Alimentaria y de Biosistemas (ETSIAAB), Universidad Politécnica de Madrid (UPM), Madrid, Spain.
[2] Unidad de Productos Fitosanitarios (UPF), Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria (INIA), Consejo Superior de Investigaciones Científicas (CSIC), Ministerio de Ciencia e Innovación, Madrid, Spain.
[3] Departamento de Producción Agraria, Área de Producción Vegetal, Escuela Técnica Superior de Ingeniería Agronómica, Alimentaria y de Biosistemas (ETSIAAB), Universidad Politécnica de Madrid (UPM), Madrid, Spain.
[4] Departamento de Medio Ambiente y Agronomía, Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria (INIA), Consejo Superior de Investigaciones Científicas (CSIC), Ministerio de Ciencia e Innovación, Madrid, Spain.
*Corresponding author: jimenezruizjesus@gmail.com

Presented at the 1st International Electronic Conference on Agronomy, 3–17 May 2021; Available online: https://sciforum.net/conference/IECAG2021

Introduction:

Herbicides application in agriculture has increased over the last 30 years, triggered by the persistence and emerging new invasive weeds. Glyphosate, the most widely used herbicide in the world, is often used to control invasive weeds. In this study, we analyzed glyphosate effects on agricultural soil properties when glyphosate is applied to control the invasive grass giant reed (*Arundo donax* L.) [1].

Materials and methods:

Glyphosate was applied at 10 L/ha. Preliminary sampling was conducted in order to determine the initial soil properties and six months after, soil samples were taken to determine the changes in the structural and chemical properties (mg HCO_3/kg, mg CO_3/kg, Kjeldahl nitrogen, organic and ammoniacal nitrogen, soil texture, pH, conductivity, dissolved oxygen and total K, Mg, Na, P), including glyphosate soil concentration.

Soil and sediment data collected: Basic physical/chemical properties of soils and sediments: granulometry, pH and conductivity. Organic matter: the organic load of the soil / sediment were analyzed . Kjeldahl Nitrogen (NKT), Total Phosphorus (PT): basic forms of nutrients. Only on the soil: Sodium (Na), Potassium (K) and Magnesium (Mg): the basic ions for plant growth were analyzed, as they are micronutrients. Carbonates and bicarbonates were analyzed to know the hardness of the soil. Glyphosate was analyzed by Gas Chromatography and Mass Spectrometry (CG-MS).

Results:

Results obtained for the physical-chemical parameters analyzed for each of the points studied before and after glyphosate application, as well as the percentage of variation between campaigns.

Before glyphosate application		After glyphosate application	
Soil	Sediment	Soil	Sediment
Glyphosate concentration (mg/Kg)	Glyphosate concentration (mg/Kg)	Glyphosate concentration (mg/Kg)	Glyphosate concentration (mg/Kg)
< 0,025	< 0,025	< 0,025	< 0,025

Table 1. Results of the analysis of glyphosate concentration in soils and sediments.

Figure 1. Glyphosate molecular structure and its main metabolites. Figure 2. Clump of Arundo donax L.

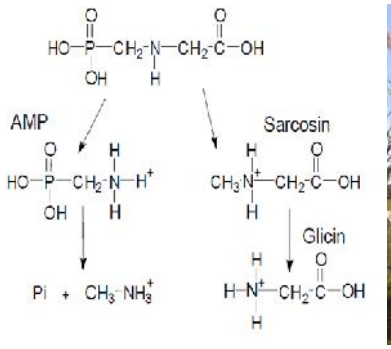

Figure 3. Location of the areas studied in the East of Spain.

Conclusions:

We can conclude that both in the soil and sediment, values of glyphosate were below the detection limit. Regarding the magnitude of the effect on the glyphosate application, no considerable changes were observed that could imply an affection or a variation in the structural characteristics and the physical-chemical properties on soils or sediments analyzed. It has been found that the trend of the results obtained between the two campaigns (before and after pesticide application) is consistent with the theoretical principles in reference to the properties of glyphosate [2, 3].

References:

1. Jiménez-Ruiz, J.; Hardion, L.; Del Monte, JP.; Vilan, B.; Santín-Montanyá, MI.; Monographs of the invasive plant in Europe Nº 4: *Arundo donax* L. *Botany Letters* 2021, 168:1, 131-151 DOI: 10.1080/23818107.2020.1864470
2. Jiménez-Ruiz, J.; Santín-Montanyá, MI. An approach to the integrated management of exotic invasive weeds in riparian zones. In Riparian zones: characteristics, management practices and ecological impacts.; OS Pokrovsky., Ed.; Publisher: Nova Science Publishers: Hauppauge (NY), 2016, pp.99-142.
3. Calderon, M.J.; Quintana, MA.; López-Piñeiro, A.; Hermosín, MC.; Cornejo, J.; Estudio preliminar sobre el comportamiento del herbicida glifosato en dos suelos de Extremadura. Estudios de la zona no saturada del Suelo Vol. VII.; 2005; ISBN 84-9749-171-8, pp. 23-28.