
The Interaction Between Roundup (Glyphosate) and Montmorillonite. Part I. Infrared Study of the Sorption of Glyphosate by Montmorillonite

S. Shoval and S. Yariv¹

Department of Geology, The Hebrew University of Jerusalem

¹ On sabbatical leave at Laboratorio Fisico-Quimica de Materiales, Instituto Venezolano de Investigaciones Cientificas, Caracas.

Abstract: The reaction between the herbicide "Roundup," $(\text{PAH})_3\text{G}$, which is the commercial name of the *iso*-propylammonium salt of glyphosate (H_3G , *N*-phosphonomethyl glycine), and montmorillonite was studied. The adsorption of the anionic component of Roundup glyphosate anion, G^{-3} , from an ethanol solution is achieved by repeated immersion of the clay film in the alcohol solution followed by drying for 6–12 hr after each immersion. During the adsorption process the surface acidity of the interlayer space must be sufficiently high to protonate the anion. A zwitterion glyphosate is thereby formed in the interlayer space. Association forms are obtained in the interlayer space in which the COOH and the PO_3H groups are linked to the exchangeable cations through water bridges. Adsorption of the glyphosate anion from aqueous solution of Roundup occurs when this anion forms a neutrally or positively charged complex with the exchangeable cation. This may occur with Al- and Fe-montmorillonite, when the molar ratio glyphosate:metal is such that a complex with a 1:1 ratio can be formed in the interlayer space. To clarify the reaction mechanism, adsorption of glycine by montmorillonite from ethanol solution was also studied. The associations obtained between glyphosate and exchangeable cations are less variable than those obtained between glycine and exchangeable cations in the interlayer space of montmorillonite. The following species of adsorbed glycine were identified: glycinium cation, zwitterion glycine, glycine complexed with metal cations either as a monodentate or as a bidentate ligand. In the latter case a chelate is formed.

Key Words: Adsorption • Glycine • Glyphosate • Herbicide • Montmorillonite • Zwitterion

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