

Environmental and Toxicological Impacts of Glyphosate with Its Formulating Adjuvant

Authors : I. Székács, Á. Fejes, S. Klátyik, E. Takács, D. Patkó, J. Pomóthy, M. Mörtl, R. Horváth, E. Madarász, B. Darvas, A. Székács

Abstract : Environmental and toxicological characteristics of formulated pesticides may substantially differ from those of their active ingredients or other components alone. This phenomenon is demonstrated in the case of the herbicide active ingredient glyphosate. Due to its extensive application, this active ingredient was found in surface and ground water samples collected in Békés County, Hungary, in the concentration range of 0.54–0.98 ng/ml. The occurrence of glyphosate appeared to be somewhat higher at areas under intensive agriculture, industrial activities and public road services, but the compound was detected at areas under organic (ecological) farming or natural grasslands, indicating environmental mobility. Increased toxicity of the formulated herbicide product Roundup, compared to that of glyphosate was observed on the indicator aquatic organism *Daphnia magna* Straus. Acute LC50 values of Roundup and its formulating adjuvant Polyethoxylated Tallowamine (POEA) exceeded 20 and 3.1 mg/ml, respectively, while that of glyphosate (as isopropyl salt) was found to be substantially lower (690–900 mg/ml) showing good agreement with literature data. Cytotoxicity of Roundup, POEA and glyphosate has been determined on the neuroectodermal cell line, NE-4C measured both by cell viability test and holographic microscopy. Acute toxicity (LC50) of Roundup, POEA and glyphosate on NE-4C cells was found to be $0.013 \pm 0.002\%$, $0.017 \pm 0.009\%$ and $6.46 \pm 2.25\%$, respectively (in equivalents of diluted Roundup solution), corresponding to 0.022 ± 0.003 and 53.1 ± 18.5 mg/ml for POEA and glyphosate, respectively, indicating no statistical difference between Roundup and POEA and 2.5 orders of magnitude difference between these and glyphosate. The same order of cellular toxicity seen in average cell area has been indicated under quantitative cell visualization. The results indicate that toxicity of the formulated herbicide is caused by the formulating agent, but in some parameters toxicological synergy occurs between POEA and glyphosate.

Keywords : glyphosate, polyethoxylated tallowamine, Roundup, combined aquatic and cellular toxicity, synergy

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