

Physicochemical characterization and formation of glyphosate-laden nano-emulsion for herbicide formulation.

ABSTRACT

A nano-emulsion system was developed for pesticide formulation. Pseudoternary phase diagrams were constructed consisting emulsion system of long-chain fatty acid methyl esters (LFAMEs)/mixed surfactant/water and a quaternary component, glyphosate isopropylamine (IPA) as a herbicide active. Isotropic (L) regions were formed in the phase diagrams using mixed surfactant long-chain alkylpolyglucosides (LAPG) and ethoxylated -(3-hydroxypropyl)-heptamethyltrisiloxane (organosilicone) at the ratios of 9:1, 8:2 and 7:3. Pre-formulation concentrates were chosen from the L regions with less than 20% (w/w) of inerts (LFAMEs + mixed surfactant) and were characterized with regard to particle size, particle aging rate and thermostability study. A pre-formulation concentrate with the lowest aging rate and stable at high temperature (54 °C) was selected for the mechanisms study of the pre-formulation concentrate in conjunction with the development of nano-emulsion formulation. The transmission electron microscopy (TEM) result showed that the pre-formulation concentrate appeared as a polymerized multi-connected network. Upon water dilution of the pre-formulation concentrate with gentle stirring (low-energy emulsification method), well-dispersed nanoparticles were formed with no needle structure being observed. The nano-emulsion particles were incorporated well with the glyphosate IPA thus inferring that this nano-emulsion system could ameliorate the bioactivity and bioavailability of the herbicide.

Keyword: Nano-emulsion; Glyphosate isopropylamine; Alkylpolyglucosides; Pesticide formulations; Low-energy emulsification