Optimizing the Doses of Chitosan/Tripolyphosphate Loaded Nanoparticles of Clodinofop Propargyl and Fenoxaprop-P-Ethyl to Manage Avena Fatua L.: An Environmentally Safer Alternative to Control Weeds

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Abstract : The global prevalence of Avena fatua infestation poses a significant challenge to wheat sustainability. While chemical control stands out as an efficient and rapid way to control weeds, concerns over developing resistance in weeds and environmental pollution have led to criticisms of herbicide use. Consequently, this study was designed to address these challenges through the chemical synthesis, characterization, and optimization of chitosan-based nanoparticles containing clodinofop Propargyl and fenoxaprop-P-ethyl for the effective management of A. fatua. Utilizing the ionic gelification technique, chitosan-based nanoparticles of clodinofop Propargyl and fenoxaprop-P-ethyl were prepared. These nanoparticles were applied at the 3-4 leaf stage of Phalaris minor weed, applying seven altered doses. These nanoparticles were applied at the 3-4 leaf stage of Phalaris minor weed, applying seven altered doses (D0 (Check weeds), D1 (Recommended dose of traditional-herbicide (TH), D2 (Recommended dose of Nano-herbicide (NPs-H)), D3 (NPs-H with 05-fold lower dose), D4 ((NPs-H) with 10-fold lower dose), D5 (NPs-H with 15-fold lower dose), and D6 (NPs-H with 20-fold lower dose)). Characterization of the chitosancontaining herbicide nanoparticles (CHT-NPs) was conducted using FT-IR analysis, demonstrating a perfect match with standard parameters. UV-visible spectrum further revealed absorption peaks at 310 nm for NPs of clodinofop propargyl and at 330 nm for NPs of fenoxaprop-p-ethyl. This research aims to contribute to sustainable weed management practices by addressing the challenges associated with chemical herbicide use. The application of chitosan-based nanoparticles (CHT-NPs) containing fenoxaprop-P-ethyl and clodinofop-propargyl at the recommended dose of the standard herbicide resulted in 100% mortality and visible injury to weeds. Surprisingly, when applied at a lower dose with 5-folds, these chitosan-containing nanoparticles of clodinofop Propargyl and fenoxaprop-P-ethyl demonstrated extreme control efficacy. Furthermore, at a 10-fold lower dose compared to standard herbicides and the recommended dose of clodinofop-propargyl and fenoxaprop-P-ethyl, the chitosan-based nanoparticles exhibited comparable effects on chlorophyll content, visual injury (%), mortality (%), plant height (cm), fresh weight (g), and dry weight (g) of A. fatua. This study indicates that chitosan/tripolyphosphate-loaded nanoparticles containing clodinofop-propargyl and fenoxaprop-P-ethyl can be effectively utilized for the management of A. fatua at a 10-fold lower dose, highlighting their potential for sustainable and efficient weed control.

1

Keywords : mortality, chitosan-based nanoparticles, visual injury, chlorophyl contents, 5-fold lower dose.

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