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Environmentally Friendly Formulations of Trifluralin Based on Alginate Modified Starch

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ABSTRACT

In line with global efforts towards sustainable agriculture, the use of starch modified with alginate in the preparation of slow release formulations of the herbicide trifluralin was investigated. Trifluralin was encapsulated in starch-alginate beads, and the resulting slow release formulations (SRFs) characterized using scanning electron microscopy (SEM) and Fourier Transform infrared (FTIR) spectroscopy. Herbicide release from the SRFs was studied in water and compared to release of technical grade trifluralin. Three sets of formulations were made by extrusion into 0.25 M calcium chloride solution: starch/alginate (SSTRF), amylose starch/alginate (ASSTRF) and amylose starch/alginate/groundnut oil (ASTRGNO) beads, and the fourth was from gelatinized starch at 75°C (SSTRF2). The results showed highly porous spherical beads, the amylose/alginate beads bigger and less porous than the starch/alginate beads with diameters of 2.79 ± 0.01 and 2.37 ± 0.01 mm; porosity of 54.67 ± 0.2 and $60.59\% \pm 0.2\%$ and swelling of 54.09 ± 0.2 and $61.22\% \pm 0.2\%$, respectively. All sets of beads exhibited reduced crystallinity of trifluralin. FTIR revealed a shift to lower wavelength of the carbonyl stretching vibrations from 1750 to 1725 cm^{-1} and a reduction in intensity of the carboxylate peaks of alginate, suggesting interactions between the formulation components that make for good slow release. 96% of technical grade trifluralin (TGTRF) was released into a 50:50 pH 6.5 Buffer/ Methanol aqueous medium in 24 hrs. However, for the starch/TRF formulation, SSTRF, only 9.33% herbicide was released after 24 hrs and 34.94% after 672 hrs (28 days). The amylose starch/TRF formulation released 13.61% herbicide in 24 hrs and 46.95% in 672 hrs, a 12% increase in release of TRF over the starch formulation. Encapsulation in starch produced 65% slow release of TRF and gelatinization achieved 84% retardation. Use of amylose starch as matrix caused 53.15% delay and addition of groundnut oil resulted in 80.87% retardation of TRF release. Encapsulation of TRF in starch/alginate beads is a veritable way of reducing negative environmental effects.

KEYWORDS

Alginate; Groundnut Oil; Starch; Slow Release; Trifluralin

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