Annexure- C-6(6.4.5)

Associateships:

The faculty member of this Institution, Dr. Atul Gupta, has research association with Dr. Abhishek Dhiman of Department of Applied Science, Mahatma Gandhi Govt. Engineering College Kotla, Rampur. They are doing research in collaboration on the development of controlled release pesticide devices and the work is mainly comprises of two parts: i.) Synthesis and design of polymeric material which can be used for encapsulating pesticide and ii) Analysing the release of pesticides from these devices. The first part is taken care by Dr. Abhishek Dhiman whereas the second part of the research is supervised by Dr. Atul Gupta. Both Dr. Atul Gupta and Dr. Abhishek Dhiman have conducted the research to develop controlled release devices for the commonly used atrazine herbicide and their work is published in International Research Journal, "Polymer Science, Series A" in this academic Session 2023-24.

ISSN 0965-545X, Polymer Science, Series A, 2023, Vol. 65, No. 6, pp. 744–754. © Pleiades Publishing, Ltd., 2023.
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POLYMER GELS

Evaluation of Environment Exposure Potential of Atrazine Herbicide and Synthesis of Polymeric Controlled Release Pesticide Formulations

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Received March 27, 2023; revised November 8, 2023; accepted November 11, 2023

Abstract—A thorough understanding of pesticide fate in soil and replacement of traditional pesticide formulations with polymeric controlled release pesticide formulations may provide a preventive approach for safer and more effective application of pesticides in the field. In this direction, the present study discusses the soil adsorption study of atrazine herbicide on Indian soil and synthesis of polymeric controlled release formulation based on *Azadirachta indica* (Neem) (AI) leaf powder and sodium alginate. The value of Ground Ubiquity Score (GUS) for atrazine herbicide has been observed 2.58 which classifies it as a transition pesticide in terms of ground water contamination with higher Environment Exposure Potential (EEP) in Indian soil. Polymeric controlled release pesticide formulations (CRPFs) were synthesized by ionotropic gelation method with three different crosslinking ions i.e. Ca^{2+}, Ba^{2+}, and Al^{3+}. These CRPFs have been characterized by FTIR, SEM-EDAX and TGA. Polymeric CRPFs released the herbicide in controlled manner for a period of 300 h and followed non-Fickian diffusion mechanism. AI-Alginate-Ca beads showed maximum cumulative release 14.99 mg/g in 300 h, followed by $BaCl_2$ and $AlCl_3$ crosslinked beads. The release study showed that the Polymeric CRPFs can be effective in controlling the release and adverse effects of atrazine in the environment.

DOI: 10.1134/S0965545X24600054

INTRODUCTION

Farming without usage of agrochemicals like pesticides, is not possible in the modern agricultural practices. Extensive population growth leading to growing food demand, has led to intensify the application of pesticides in fields. Wide application of agrochemicals has led to severe health effects of humans and animals [1, 2]. Despite the dangerous health hazards, the usage of these pesticides cannot be stopped at once. Without using agrochemicals, either the crop is damaged by the herb, pests, fungus or it doesn't have proper growth due to lack essential nutrients in soil. In case of pesticide, less than 5% of the used pesticide actually reaches the target and rest of it goes into the environment. Most of the pesticide used in agriculture seeps into water bodies through leaching and the process of leaching for a pesticide is inevitable [3]. In soil, pesticide may travel in soil solution phase or gets adsorbed to the solid soil particles. This behavior determines the final fate of pesticide and the extent of surface water and ground water contaminations [4, 5].

The agro-environmental pollution derived by pesticide usage can also be reduced with the help of polymeric controlled release pesticide formulations (CRPFs). Conventional pesticide formulations release the active ingredient immediately causing quick loss of agrochemicals via degradation, volatilization, evaporation and leaching. An ideal pesticide formulation could be the one which can control the amount available at any time to be adequate for pest control and leave minimum residues on crops and in environment. This can be achieved by the use of polymeric CRPFs [6–9]. Natural origin polymers like alginates have gained attention for synthesis of CRPFs because they not only control the pesticide release in environment but also increase the water holding capacity of soil. In addition to these natural polymers are eco-friendly, cost effectiveness, easily available, biodegradability and may have inherent pest repelling tendency. Alginate is a linear polysaccharide, which easily forms a crosslinked polymer bead with divalent or trivalent metal ion. Alginate is mostly used in combination with another polymer to form bi-polymeric beads [10]. In present case *Azadirachta indica* (Neem) (AI) leaf powder has been used as the second component for bead formation. AI leaf powder is well known for its pest