A STUDY ON PESTICIDE MOBILITY AND PERSISTENCE FOR GEO-ENVIRONMENTAL POLLUTION

by

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Submitted

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CERTIFICATE

This is to certify that the thesis, entitled **"A Study on Pesticide Mobility and Persistence for Geo-Environmental Pollution"**, being submitted by Ms Manika Gupta to the Indian Institute of Technology, Delhi for the award of Doctor of Philosophy, is a record of bonafide research work carried out by her under our supervision. The thesis work, in my opinion has reached the standard, fulfilling the requirements for the said degree. Further, I certify that this submission is Ms. Gupta's own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person which to a substantial extent has been accepted for the award of any other degree or diploma of any University or Institute, except where due acknowledgment has been made in the text.

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ABSTRACT

Wheat (*Triticum aestivum* L.) is an important cereal food crop in India and is considered in the present work to study the behaviour (persistence and mobility in soil) of the pesticides for the wheat crop in the study area, India. In order to study the pesticides under field conditions, the experimental plots were made in the agriculture field itself in Saliyar village, Roorkee, India. The potential movement and persistence of the three pesticides, used in protecting wheat crop, that is, Thiram; 2, 4-D; and Isoproturon was investigated under three different irrigation treatments. The irrigation treatments consisted of irrigation scheduling based on maximum allowable depletion (MAD) of available soil water (ASW) criteria, taken as 25%, 50% and 75%. The soil water contents and pesticides residue were determined in soil at temporal and spatial scale. The studied pesticides showed varied behavior under the three irrigation treatments employed in the three plots. Thiram being a non-polar pesticide was not found to be sensitive to the different irrigation treatments and Thiram residue showed almost same trend spatially and temporally in the three plots. However, for the two pesticides, 2, 4-D, and Isoproturon, mass transport differed among all the plots under different irrigation treatments. For all the three pesticides, the bulk mass of pesticide residue remained confined to the top 15 cm of the soil. The current existing dosage of 0.5 kg ha^{-1} of 2, 4-D and 0.8 kg ha^{-1} of Thiram were found to be safe to avoid soil contamination as no residue of any pesticide was traced at the end of the wheat crop season in any of the plots. However, 0.5 kg ha^{-1} of Isoproturon was not sustainable under low irrigation treatments as low concentrations were persisting in soil at the end of the crop period.

Numerical simulations were also carried out by solving the coupled water flow and solute transport equations using numerical model, HYDRUS-1D. The soil hydraulic parameters can either be determined by fitting van Genuchten equation to the experimentally determined soil

water retention curves (SWRC) or by the use of PTFs. The experimentally determined soil water contents could only be poorly simulated using PTFs with negative model efficiencies. However, experimentally determined soil water contents were simulated with high average efficiencies in the range of 80% when the optimized soil hydraulic parameters were used. Hence, the optimized soil hydraulic parameters were used in the coupled water flow and solute transport equations to simulate pesticide persistence and mobility. Numerically simulated results for pesticides residues showed a good agreement with the experiments with high model efficiencies being above 80%.

The pesticide regulation and various scenarios generated, suggested that the irrigation treatments may govern the safe dosage of pesticide application such that it does not have a carry-over effect of the residue in soil at the end of the crop period. The pesticides residues were found to persist in general under rain-fed conditions at the above existing dosage for all the three studied pesticides.

CONTENTS