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Research Article

Sorption of pyrazosulfuron-ethyl by soils of different agro-climatic zones of Southern Karnataka

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Summary

Sorption studies were conducted with pyrazosulfuron-ethyl using batch equilibration technique and HPLC analysis. Four different paddy growing soils of Kathalagere, Mandya, Mudigere and Mangalore soil of Southern transitional zone, Southern dry zone, Hilly zone and Coastal zones of Southern Karnataka were used in the study with a pH of 7.3, 6.9, 6.1 and 5.8 and organic matter (g kg^{-1}) of 12.9, 10.9, 6.4 and 10.4, respectively. The sorption isotherm (n) values were 0.104, 0.101, 0.085 and 0.165 for Kathalagere, Mandya, Mudigere and Mangalore soils, respectively. The sorption isotherm for pyrazosulfuron-ethyl was non-linear in all soils, as explained by the Freundlich equation (n < 1.0), indicating differential distribution of site energies for sorption. In general adsorption isotherms fitted well with Freundlich equation (r^{-2} > 0.96), and Freundlich constants 'K', 'Koc' and 'K_c' values were in the range from 5.45 to 9.52, 1099.46 to 1436.12 and 32.24 to 49.07 in different soils and described in the order of Kathalagere > Mandya > Mudigere > Mangalore, which is also in the order of decreasing organic matter content in the soils. The coefficient of determination showed an improvement up to 96 per cent using quadratic functions, suggesting a better goodness of fit in preceding pyrazosulfuron-ethyl sorption compared to the linearised form of the Freundlich equation. The cumulative desorption of five days of pyrazosulfuron-ethyl in these soils were determined and it ranged from 22.3 to 41.1 mg kg^{-1} in Kathalagere soil, 25.6 to 49.4 mg kg^{-1} in Mandya soil, 37.1 to 51.9 mg kg^{-1} in Mudigere soil and 39.9 to 55.7 mg kg^{-1} in Mangalore soil. The desorption was also in decreasing order of Mangalore > Mudigere > Mandya > Kathalagere soils. The sorption of pyrazosulfuron-ethyl increased with increasing organic matter content and was significantly correlated with organic matter content of the soils where as clay content did not greatly affect the sorption as indicated by low regression coefficient.

Key words : Pyrazosulfuron-ethyl, Sorption, Freundlich equation, HPLC

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Introduction

The fate of an herbicide applied to the soil is governed to a large extent by its adsorption on soil constituents, desorption of adsorbed herbicides, its persistence and degradation. Soil sorption study of a pesticide, can generate useful information regarding its fate in soil and provide a basis for its effective use in the field to reduce undesirable effects due to carry over, contamination and phytotoxicity. A survey literature (Calvet, 1980; Guenzi, 1974; Hamaker, 1972; Khan, 1980) show that much less attention has been paid to desorption compared to adsorption. Plant uptake, bio-efficacy and transport mainly depend on sorption equilibrium. pyrazosulfuron-ethyl is a highly active sulfonylurea herbicide and is mainly registered for use in paddy fields. This chemical is available in commercial names of Sathi, Agreen, Sirius, Act, Spark, Star and Billy. This herbicide has become more popular due to its high activity at low application rates and low mammalian toxicity. Although pyrazosulfuron-ethyl would appear to be degraded rapidly in soils like other sulfonylureas (Kim *et al* 2003a and 2003b; Mikada *et al* 1996). Pyrazosulfuron-ethyl herbicide application in soil leads to various reaction in