# Modeling Hormesis in Rhizoremediation of Petroleum Contaminated Sites

**Michael Eze, Simon George, Grant Hose**
Macquarie University, Sydney

9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

## Abstract

Around the globe, hydrocarbon contamination continues to be the most persistent environmental menace resulting from oil and gas operations. Rhizoremediation, a bioremediation technique whereby microbial degradation of organic contaminants occurs in the rhizospheric zones of plant, is gaining growing attention. This is due to plant's ability to recruit beneficial microbes through root exudation.Examination of the published scientific literature, however, reveals that while petroleum hydrocarbons are toxic to most plants, they could exert hormetic influence on a few species. Hormesis occurs when contaminants stimulate beneficial responses in test species at low doses. Traditionally, dose-response models are based on strictly monotone functions, such as the log-logistic, log-normal and Weibull functions. These traditional functions are either strictly decreasing from a maximal control response at zero dose to a lower limit at infinite dose or are strictly increasing from no effect at zero dose to maximum effect at infinite dose, depending on whether the response or the effect is being assessed. These functions therefore cannot be used to model dose responses that exhibit initial response stimulation. During the past decade or two, the phenomenon of hormesis has gained increased recognition. Evidence is accumulating that stimulatory responses to low levels of stress probably are the rule rather than the exception.Through a microcosm study, my research investigated the potentials of selected plant species for rhizoremediation of diesel fuel by recruiting beneficial microbes under different contaminant concentrations. Our results reveal that while petroleum hydrocarbons impacted on the growth of most plants, it had a hormetic influence on Medicago sativa. In addition, choosing the right statistical tools for dose-response analysis was shown to be especially important

when hormesis is observed. Finally, our results reveal the right approach to modelling hormesis when assessing plants' potentials for rhizoremediation of petroleum hydrocarbons. We believe that the results of our research will provide helpful information for scientists interested in modelling hormetic behaviour in contaminant remediation, as well as form the basis for evidence-based environmental policy.