Application of the Eyring-Stover survival theory to soil-related functions

(^{32}P uptake/bean plant growth/ ^{14}C retention/ NO_3^- N soil loss)

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Contributed by Henry Eyring, February 19, 1980

ABSTRACT The fit of the Eyring-Stover statistical survival theory was found to be precise when applied to diverse soil-related functions.

Introduction

In the period 1970-1974 Eyring, Stover, and colleagues (1-5) developed a statistical survival theory. Briefly, the theory states the probability of survival, S , of an individual in a homogeneous population is given by

$$S = (1 + e^{-(a-bt)})^{-1},$$

in which a is the measure of the organisms' reserve used to resist forces leading to death, b is the measure of the difference between rate constants for damage and recovery, and t represents time. Successful applications of the Eyring-Stover theory to ecological phenomena have been presented in an earlier paper (6). The application of the theory to other phenomena is of further interest to us. Hence, we have computed the least square best fit of the model to soil-related functions as follows (curves in all the figures are computed, points are experimental data). The data were selected randomly.

Applications

It can be seen in Fig. 1 that the theory provides an excellent fit to the data of Olsen *et al.* (7) when plant uptake of phosphorus is plotted as a function of time. Congruence is also found with respect to the Wadleigh and Ayers (8) data when plant growth

FIG. 1. Effect of time on ^{32}P uptake by corn seedlings at 3 bars (300 kPa) moisture tension ($a = 3.95$, $b = 0.1675$).

FIG. 2. Bean plant growth as a function of salt concentration (NaCl) at three moisture tensions.

is plotted as a function of salt concentration at three soil moisture tensions (Fig. 2). Fig. 3 illustrates the close match of the theory to the plant decomposition data of Jenkinson (9). The model also gives a precise fit to the soil denitrification data of Kohl *et al.* (10) (Fig. 4).

FIG. 3. Retention of ^{14}C in soils incubated in the field with labeled ryegrass (average for all treatments) ($a = 7.42$, $b = 0.212$).

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FIG. 4. Loss of $\text{NO}_3^- \text{N}$ with time from two soils.

The overall fit of the Eyring-Stover theory to these diverse soil-related functions attests further to the generality of the model. The realization of its ultimate value for prediction must await further analysis.

We thank Professor William Gray for use of his DEC PDP-8 computer.

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