Bi-stable dynamics of a host-pathogen model

Roumen Anguelov[1], Rebecca Bekker[1], Yves Dumont[1,2]

[1] Department of Mathematics and Applied Mathematics, University of Pretoria
Pretoria, South Africa
roumen.anguelov@up.ac.za, rebeccaabekker@gmail.com
[2] CIRAD, Umr AMAP, Montpellier, France
yves.dumont@cirad.fr

We discuss a model of the spread of a soil pathogen in roots. The model can be considered an extension of the compartmental model of [1] by including compartments for the pathogen. In this way we can consider the spread of the infection through the spatial diffusion of the free (unattached) pathogen, which we believe is a more realistic approach. We show that for the space independent model the pathogen free equilibrium (PFE) is always asymptotically stable, and the persistence of the infection occurs only in the setting of bi-stability. Condition for global asymptotic stability of PFE are derived using two methods: (i) Lyapunov function, and (ii) construction of a monotone system that approximates the model from above. These methods lead to two sets of sufficient conditions for the global stability. The parameter values satisfying these conditions have some overlap. However, there are values that satisfy one set and not the other. Numerical investigation of the long term behaviour of the system with spatial diffusion is carried out.

References

[1] C.A. Gilligan, *Modelling soil-borne pathogens: reaction-diffusion models*, Canadian Journal of Plant Pathology **17**(1995), 96–108.