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On synergistic co-infection in crop vector-borne diseases

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Major constraint to crop productivity are pests and diseases that cause major food insecurity throughout the world, especially in Southern Countries. The Food and Agriculture Organization estimates that pests and diseases are responsible for about 25% of crop loss. A new deadly disease of maize was reported in many Southern Countries, the Maize Lethal Necrosis Disease (MLND). For instance, in Kenya alone, the MLND affected around 77 000 ha, translating into an estimated loss of US $ 52 million. The MLND results from a synergistic interaction between the Maize Chlorotic Mottle Virus (MCMV) and one of several viruses from the Potyviridae family, like the Sugarcane Mosaic Virus (SCMV). In this talk, we focus on modelling and analysis of MLND. However, our model is sufficiently generic to be applied to different co-infection vector borne diseases. A theoretical analysis shows that different equilibria and thresholds exist: the basic reproduction numbers and the invasion reproduction numbers. We show that these thresholds drive the dynamics of the MLND system. In particular, the invasion reproduction numbers are essential for the emergence or not of the MLND. We illustrate our results through numerical simulations and discuss potential control methods. This work has been published in [1].

Key words: Crop disease, synergistic interaction, basic reproduction number, invasion reproduction number, numerical simulations.

References

[1] Michael Chapwanya, Americo Matusse, and Yves Dumont. On synergistic co-infection in crop diseases. The case of the maize lethal necrosis disease. Applied Mathematical Modelling, 90:912-942, 2021.