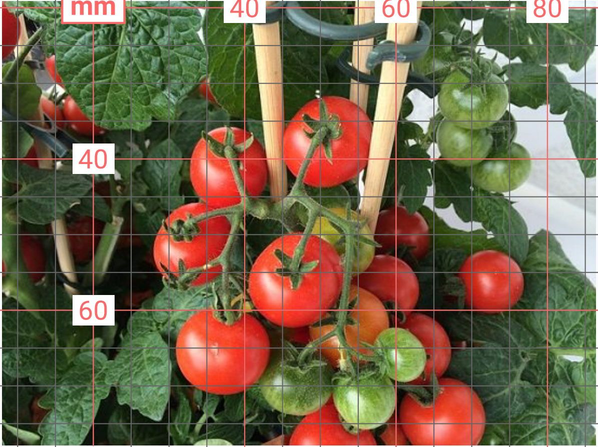
Modeling optimal control policies

in stochastic epidemic models

Saúl Díaz Infante Velasco

CONACYT-UNIVERSIDAD de SONORA

Tomato leaf curl virus disease (TYLCVD)



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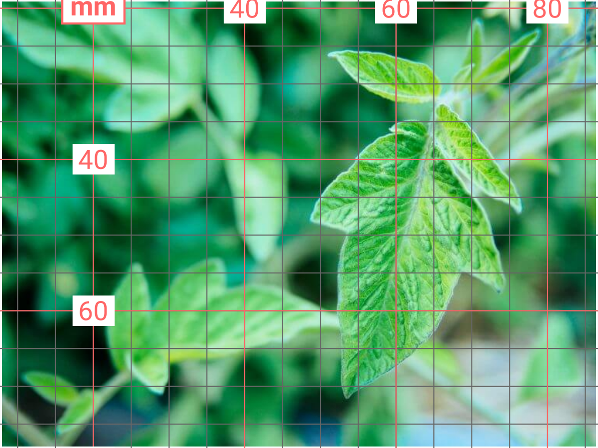

Tomato leaf curl virus disease (TYLCVD)

SIAM Society for Industrial and Applied Mathematics

- Tomato plants **infected early** are severely stunted and will **not produce fruit**
- Leaflets are small and yellowed with edges that curl upwards
- Flowers either do not develop or fall off
- When **older plants** are infected, fruit that is already forming ripens normally, but **no new fruit** is formed after the infection
- TYLCV can be confused with several other conditions such as tomato big bud, herbicide damage and phosphate or magnesium deficiency

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Spread

- **TYLCV** is spread by the insect silverleaf whitefly (Bemisia tabaci B biotype)
- Silverleaf whiteflies pick up the virus by feeding on infected host plants. The whiteflies then spread the virus to healthy plants **which show the symptoms 10 to 21 days later**
- Silverleaf whiteflies are **common** in many countries and **feed** on **many** types of **plants**

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Control

Cultural Control

- Physical barriers
- Planting dates
- **Removal of infested plants**
- Host plant resistance

Biological Control

- Parasitoids
- Predators
- Fungi

Insecticides

- pymetrozine
- zeta-cypermethrin / bifenthrin

Shun-xiang, R., Zhen-zhong, W., Bao-li, Q., and Yuan, X. (2001). **THE PEST STATUS OF BEMISIA TABACI IN CHINA AND NON-CHEMICAL CONTROL STRATEGIES.** *Insect Science*, 8(3):279–288.

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Table of contents

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40

60

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\begin{aligned}
\frac{dS_p}{dt} &= -\beta_p S_p I_v + r(L_p + I_p) \\
\frac{dL_p}{dt} &= \beta_p S_p I_v - bL_p - rL_p \\
\frac{dI_p}{dt} &= bL_p - rI_p \\
\frac{dS_v}{dt} &= -\beta_v S_v I_p - \gamma S_v + (1-\theta)\mu \\
\frac{dI_v}{dt} &= \beta_v S_v I_p - \gamma I_v + \theta\mu
\end{aligned}
$$

Par.	Value	Descrip.
β_p	0.1	latent rate
r	0.01	remove rate
$1/b$	0.075	time of latency
γ	0.06	vector die or depart rate
μ	0.3	immigration rate
θ	0.2	infected vectors arrival
β_v	0.003	vector infected rate

$$
R_0 = \sqrt{\frac{\beta_v \mu b \beta_p}{r^2(r+b)\gamma}}
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DFE = (N_p, 0, 0, 0, \mu/\gamma)^\top
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EE = (S_p^*, L_p^*, I_p^*, S_v^*, I_v^*)^\top
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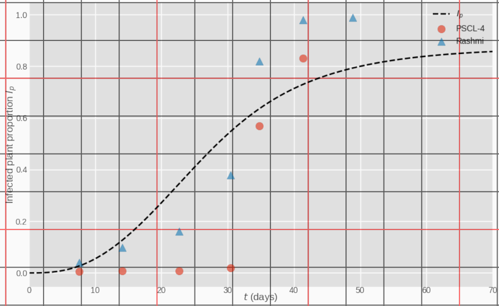

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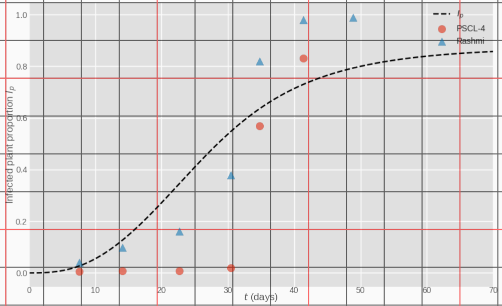

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