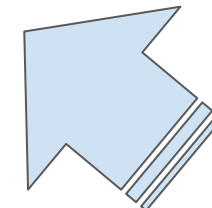
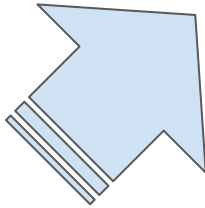
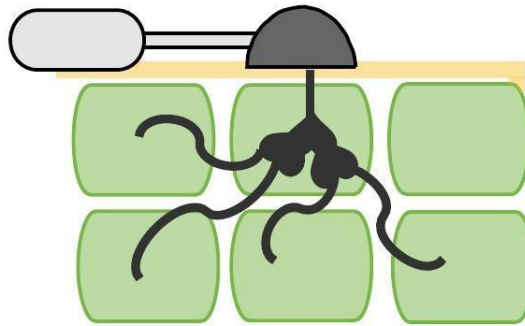
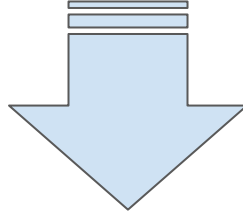


# Genes de resistencia. Sistemas de virulencia/avirulencia

Oscar Burbano-Figueroa

# El triángulo de la enfermedad

Condiciones ambientales



Interacción

Hospedero - Patógeno



# Que es resistencia?

Resistencia es la habilidad de un organismo de excluir o evitar, completa o parcialmente, el efecto de un patogeno u otro efecto dañino.

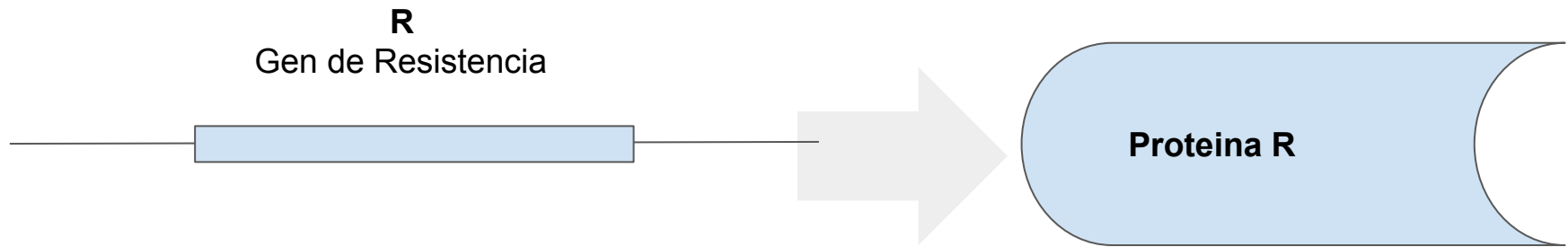
Resistencia

**Resistencia Vertical**

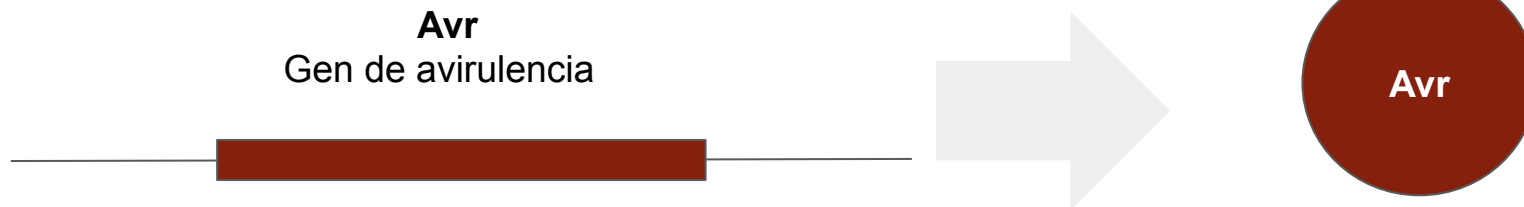
**Resistencia Horizontal**

# Componentes básicos de la Resistencia vertical

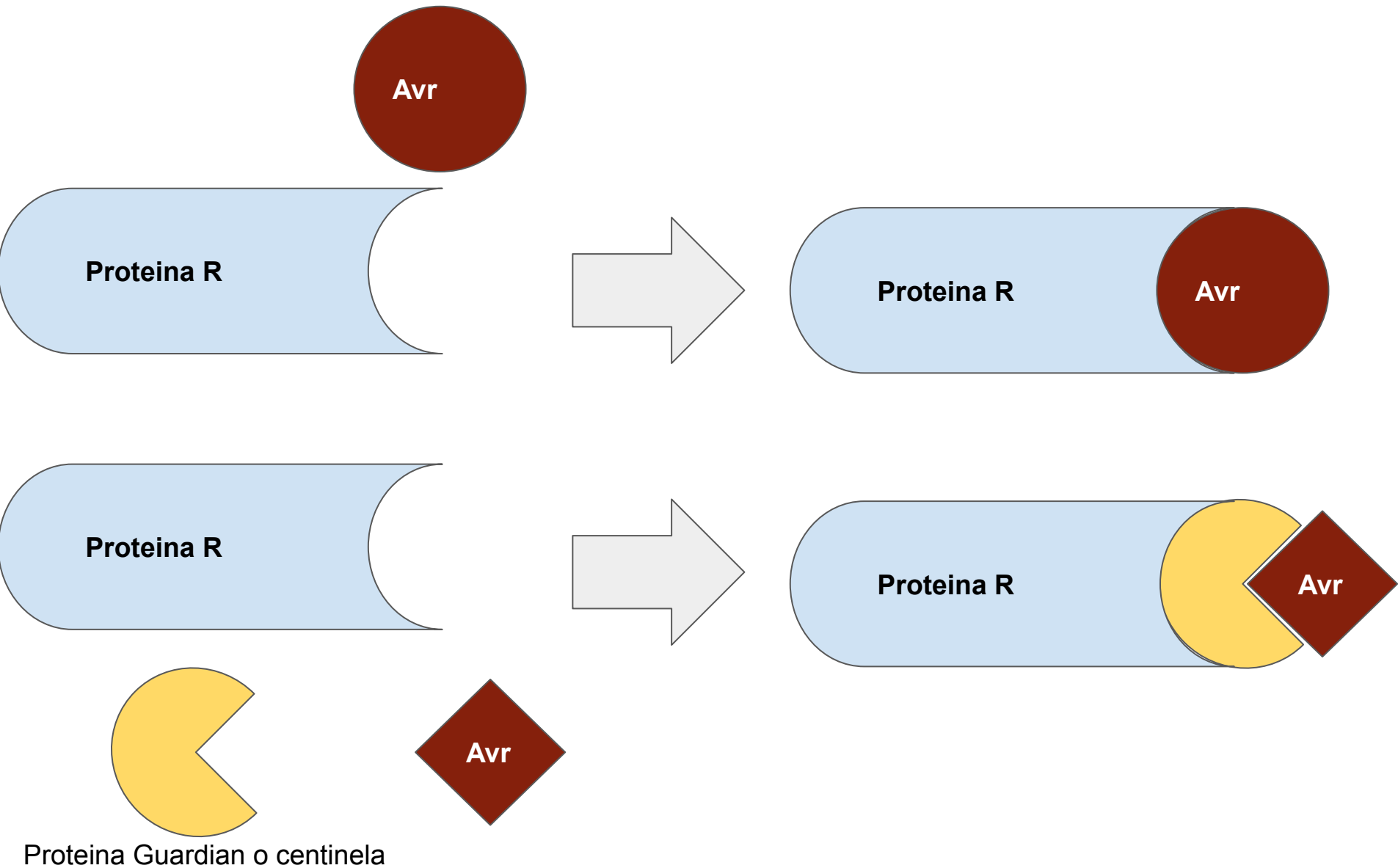
## Planta hospedera



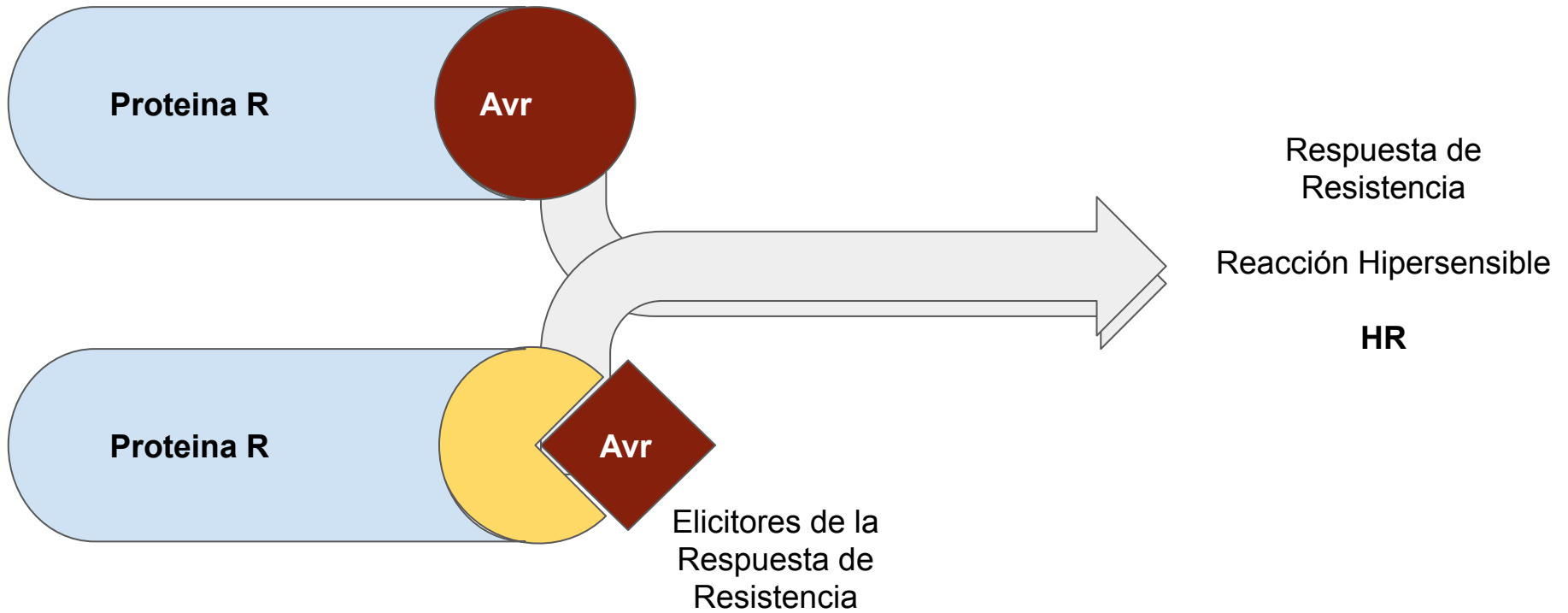
## Patogeno



# Interacción entre proteínas R y Avr



Interacción entre proteínas R y Avr



# Reacción Hipersensible y Apoptosis

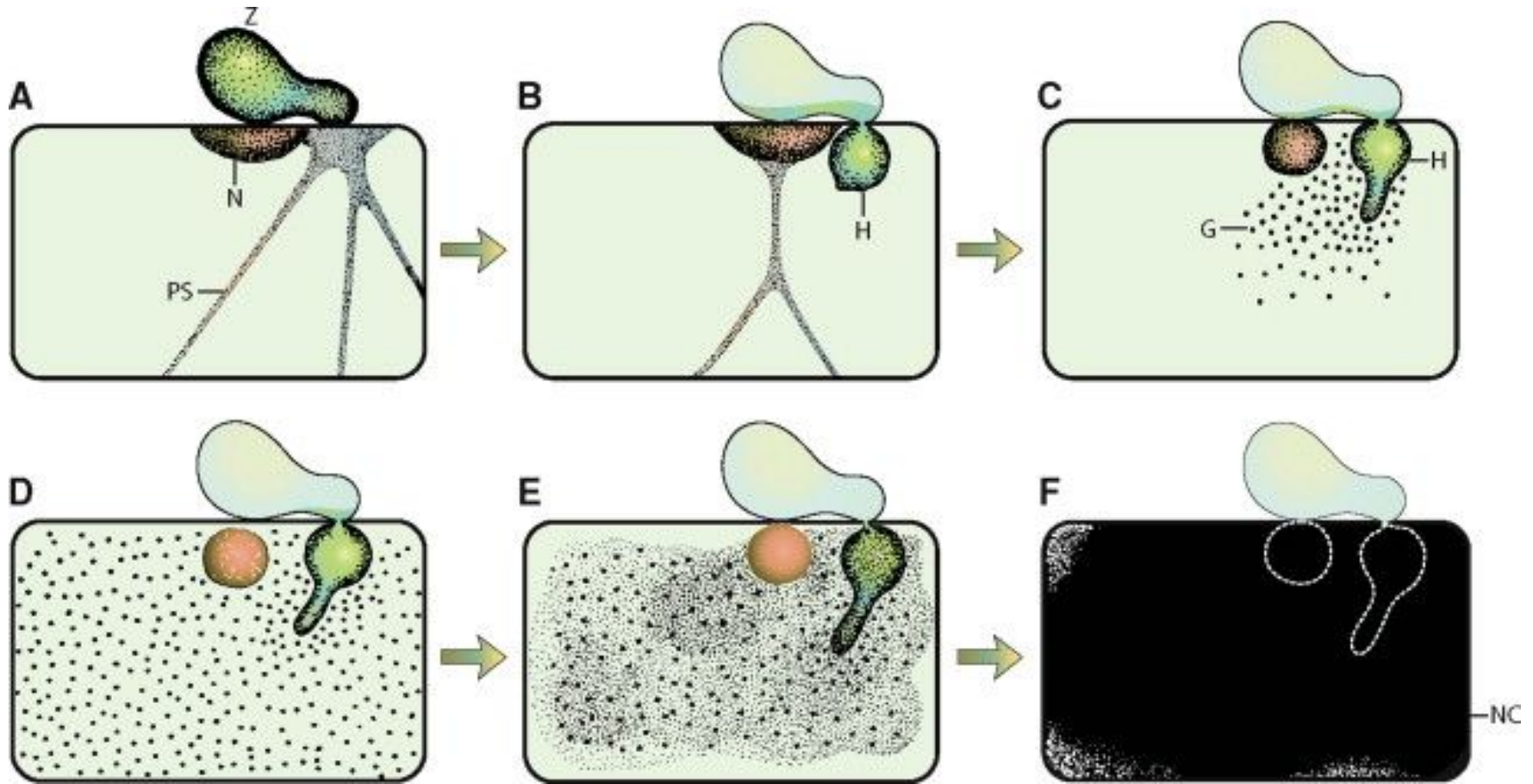


FIGURE 6-9. Stages in the development of the necrotic defense reaction in a cell of a very resistant potato variety infected by *Phytophthora infestans*. N, nucleus; PS, protoplasmic strands; Z, zoospore; H, hypha; G, granular material; NC, necrotic cell. [After Tomiyama (1956). *Ann. Phytopathol. Soc. Jpn.* 21, 54–62.]

# Respuesta hipersensible

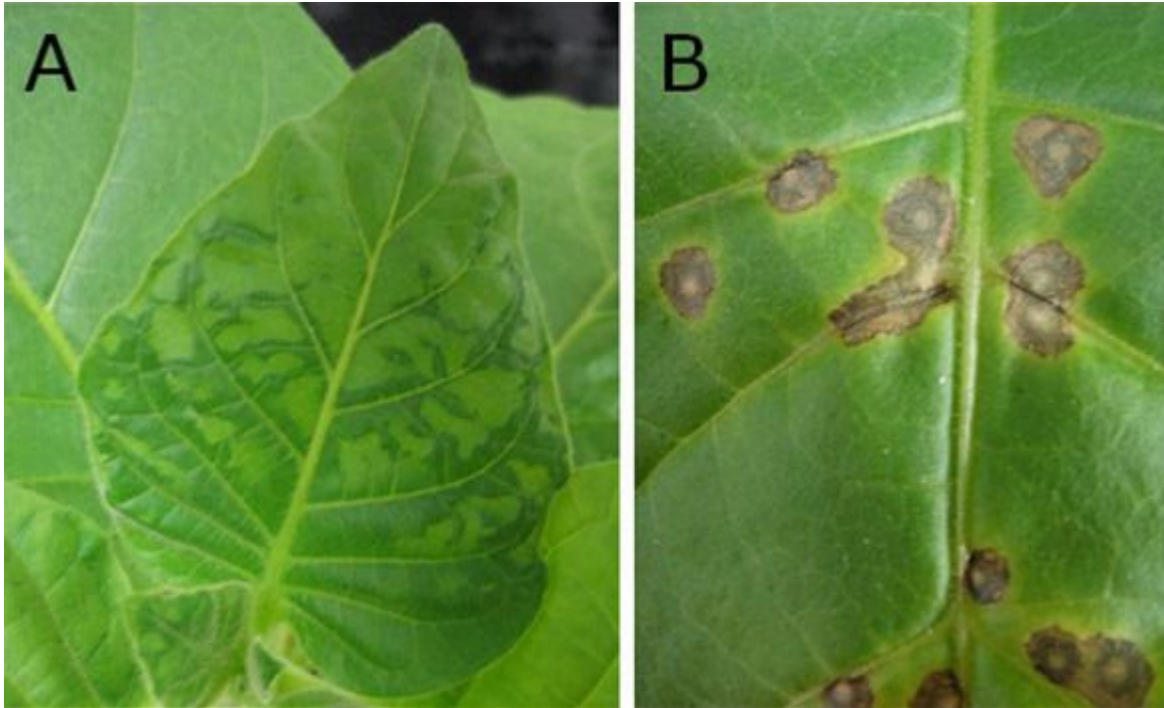


Fig. 2. Hypersensitive response (HR) in tobacco (A) Mosaic symptoms caused by tobacco mosaic virus on a susceptible tobacco leaf. (B) Hypersensitive cell death by tobacco mosaic virus on a resistant tobacco leaf. Photo K.B.G. Scholthof.



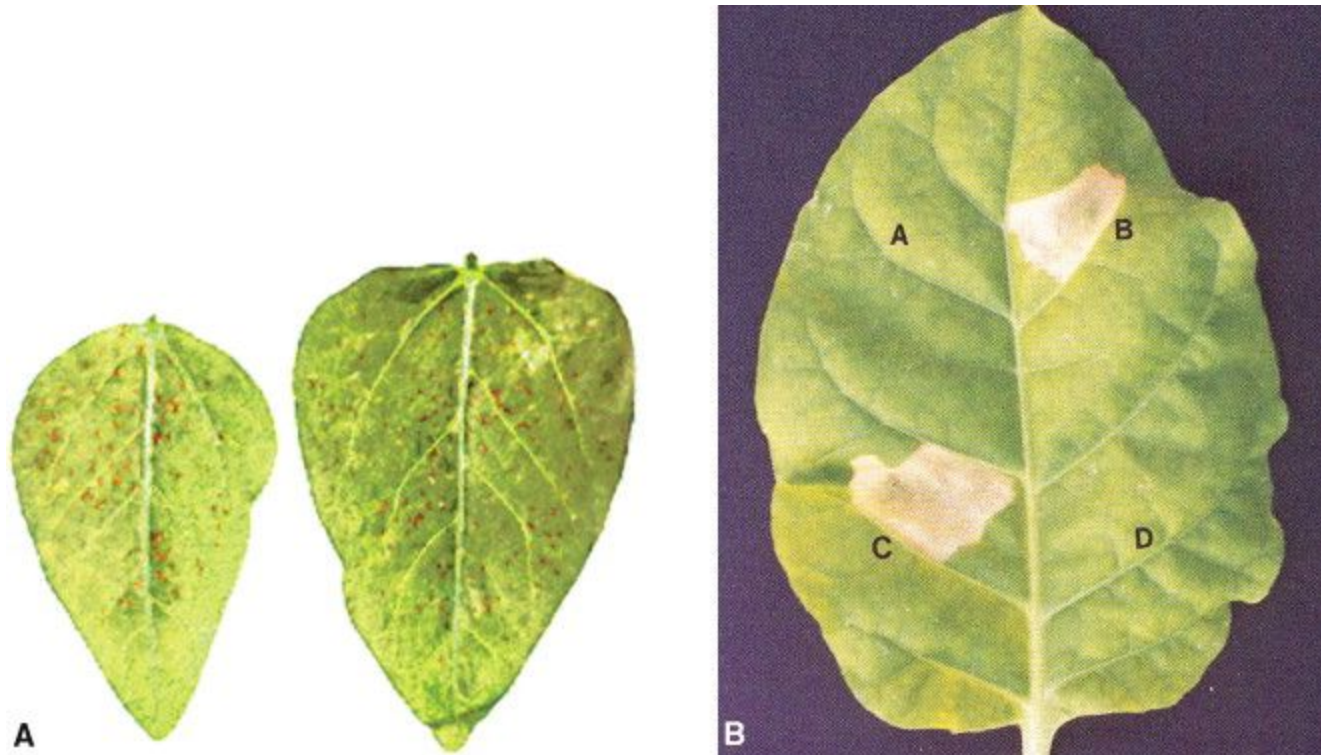
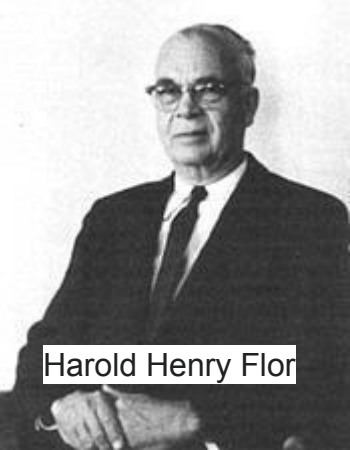


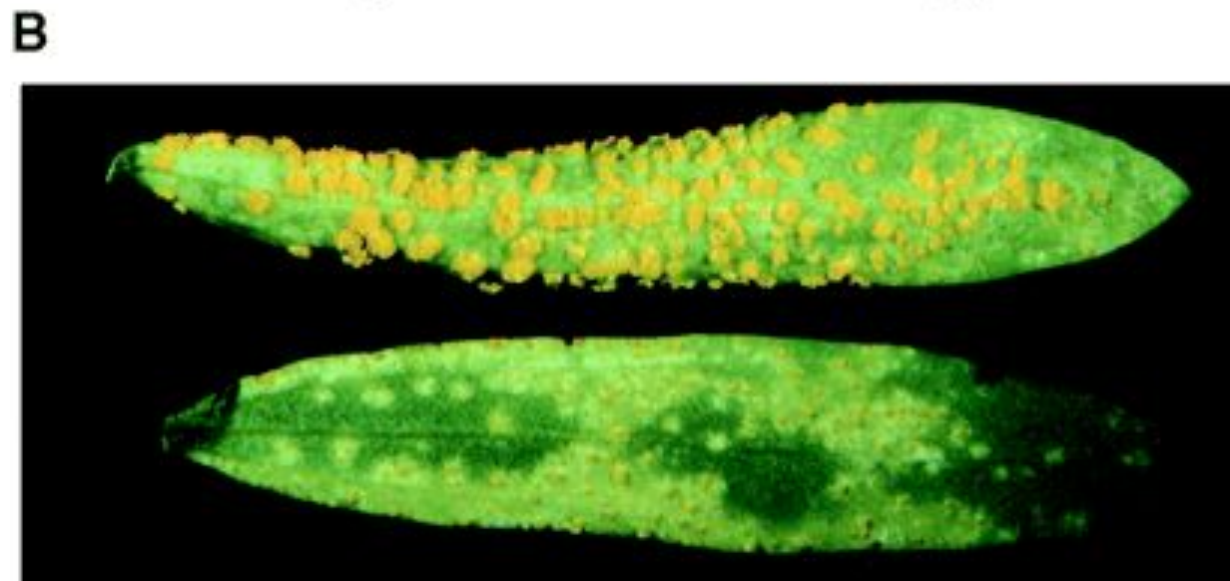
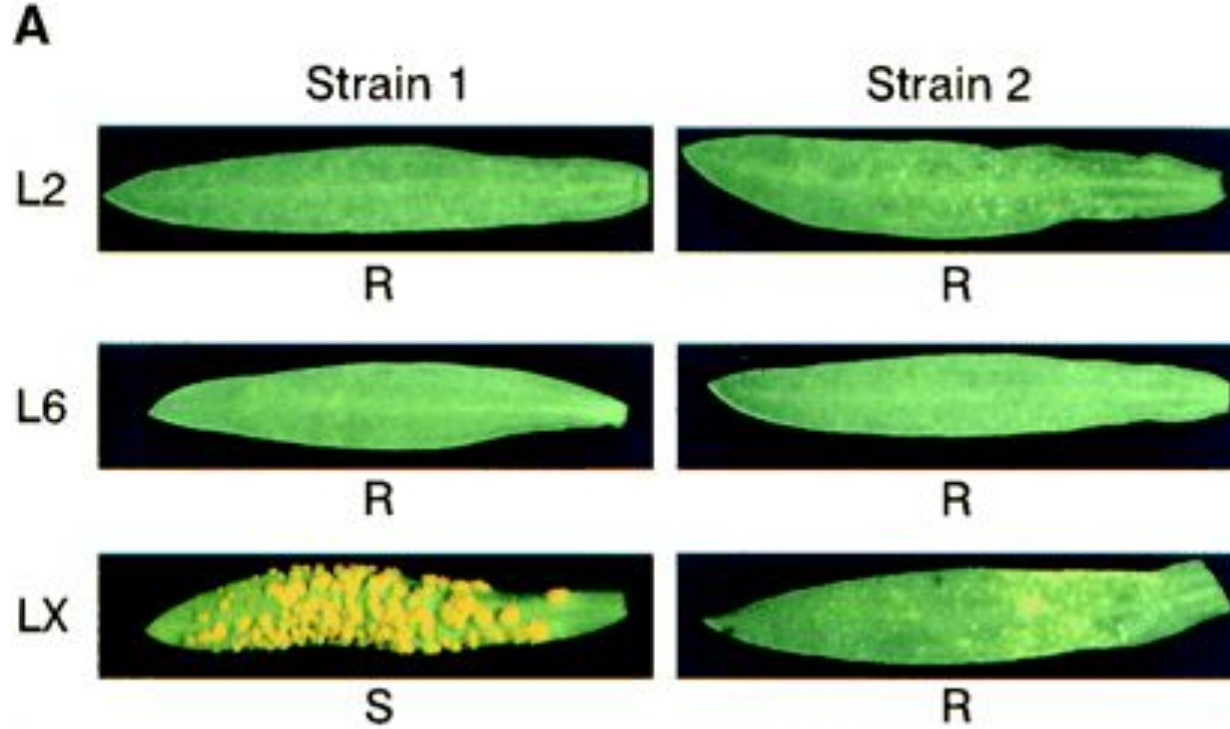
FIGURE 6-10. (A) Hypersensitive response (HR) expressed on leaves of a resistant cowpea variety following sap inoculation with a strain of a virus that causes local lesions (in this case, *alfalfa mosaic virus*). The virus remains localized in the lesions. (B) Tobacco leaf showing typical hypersensitive responses (white areas) 24 hours after injection with water (A) or with preparations of bacterial strains B, C, and D. Strain (B), which does not infect tobacco, and (C), which carries a *hrp* (hypersensitive response and pathogenicity) gene, both induced the hypersensitive response, whereas the third strain (D), a mutant of C that lacked the *hrp* gene, did not.

# Hipotesis de interacción gen por gen de Flor

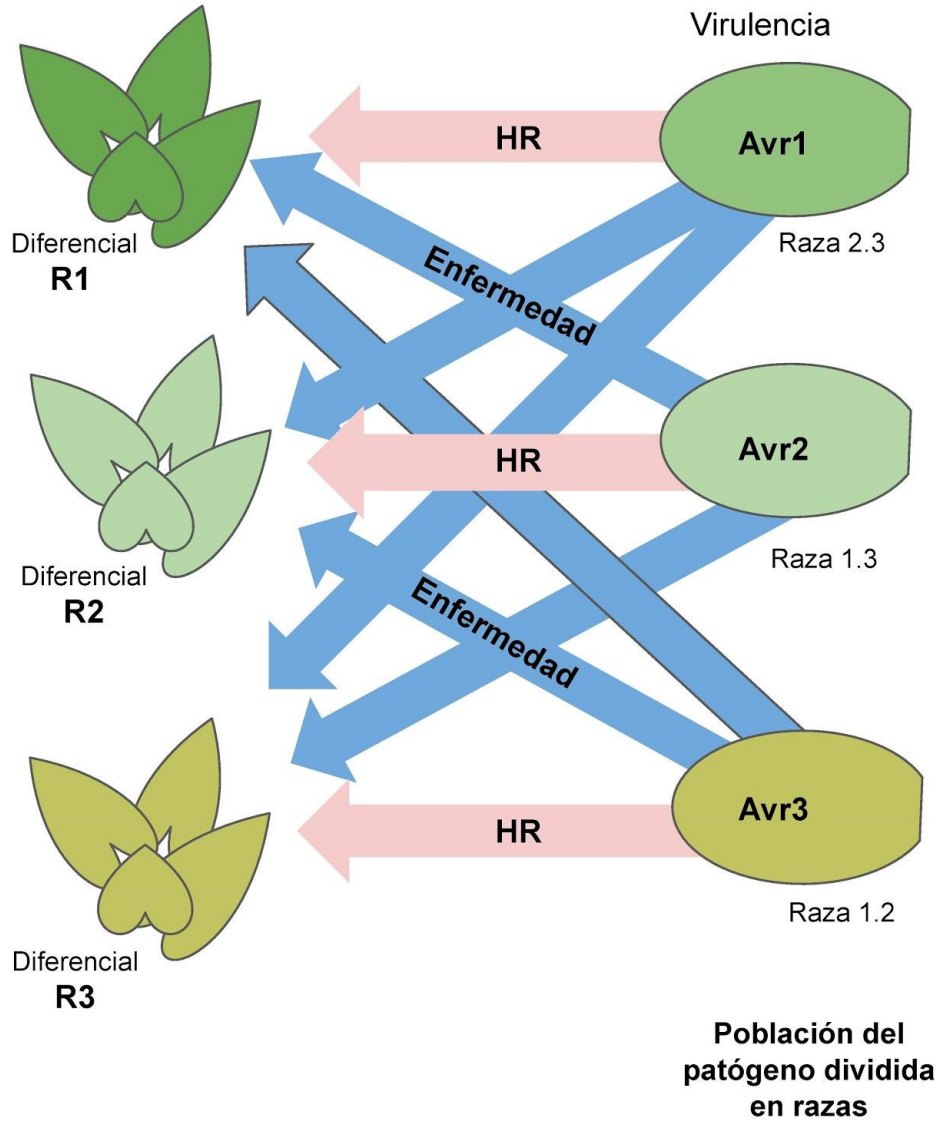
		Genotipo de la planta		
		rr	R_	
Genotipo del patogeno	avr / avr	Enfermedad	Enfermedad	Reacción compatible
	Avr_	Enfermedad	Resistencia	Reacción incompatible



Harold Henry Flor

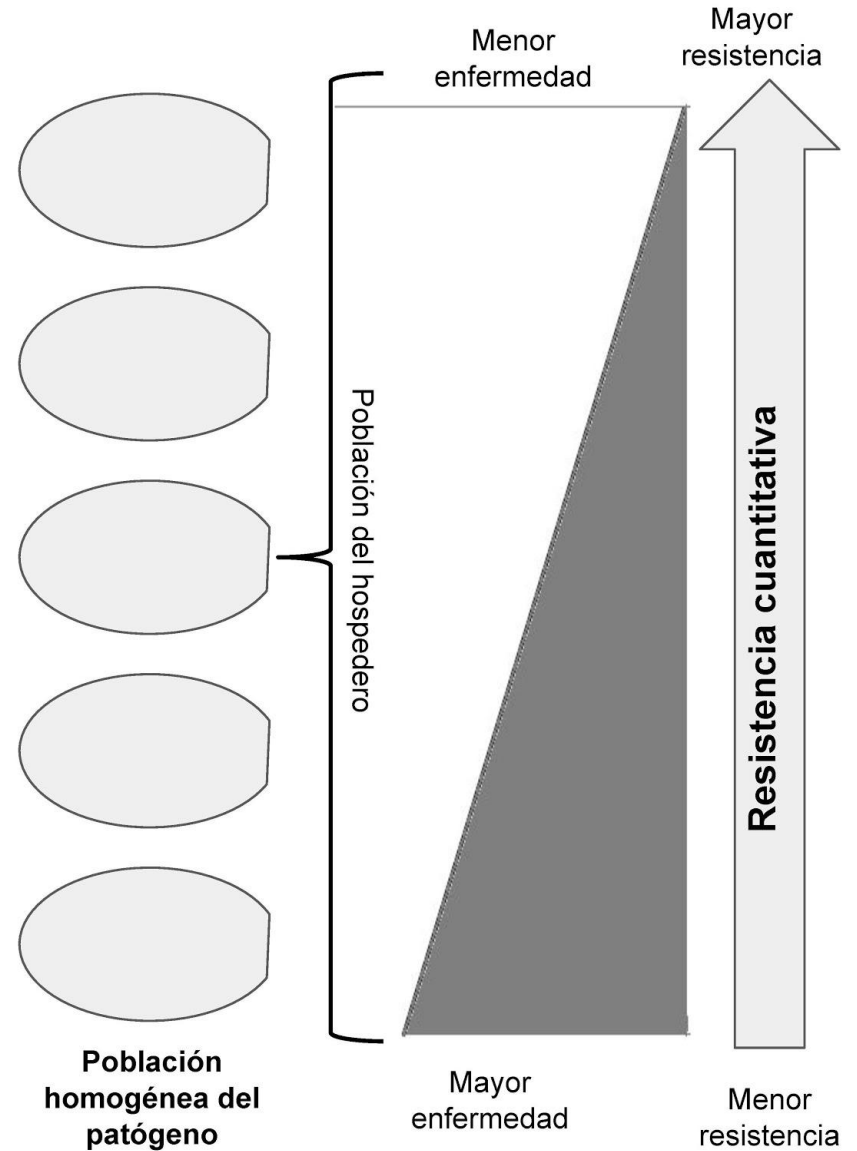


## Resistencia vertical



Interacciones específicas

## Resistencia horizontal

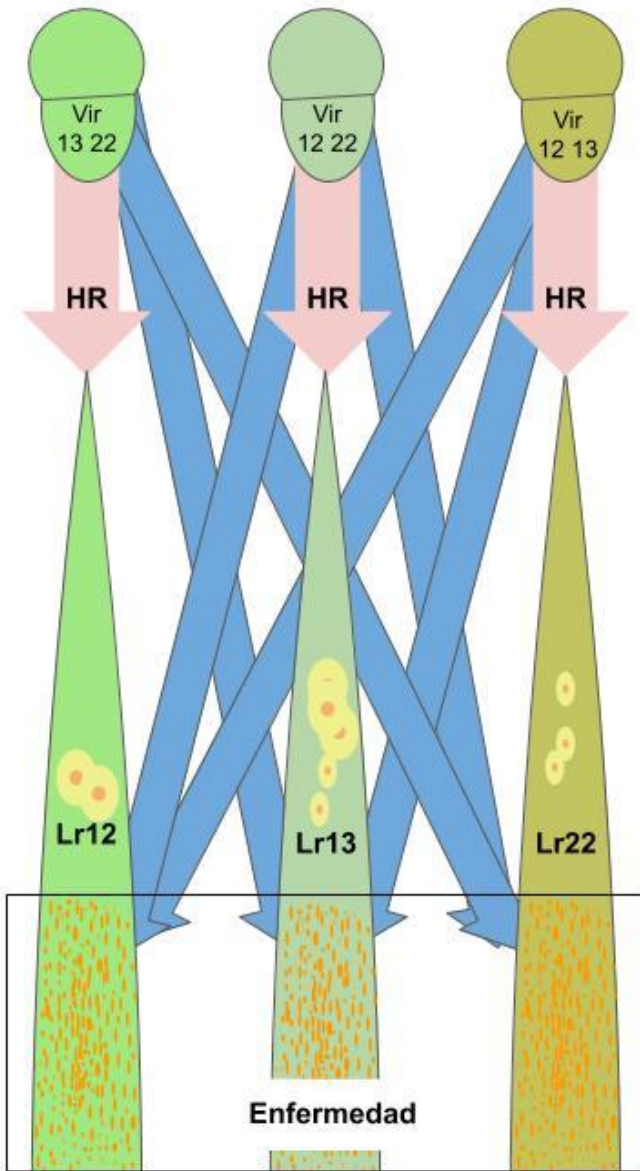


Ausencia de interacciones específicas



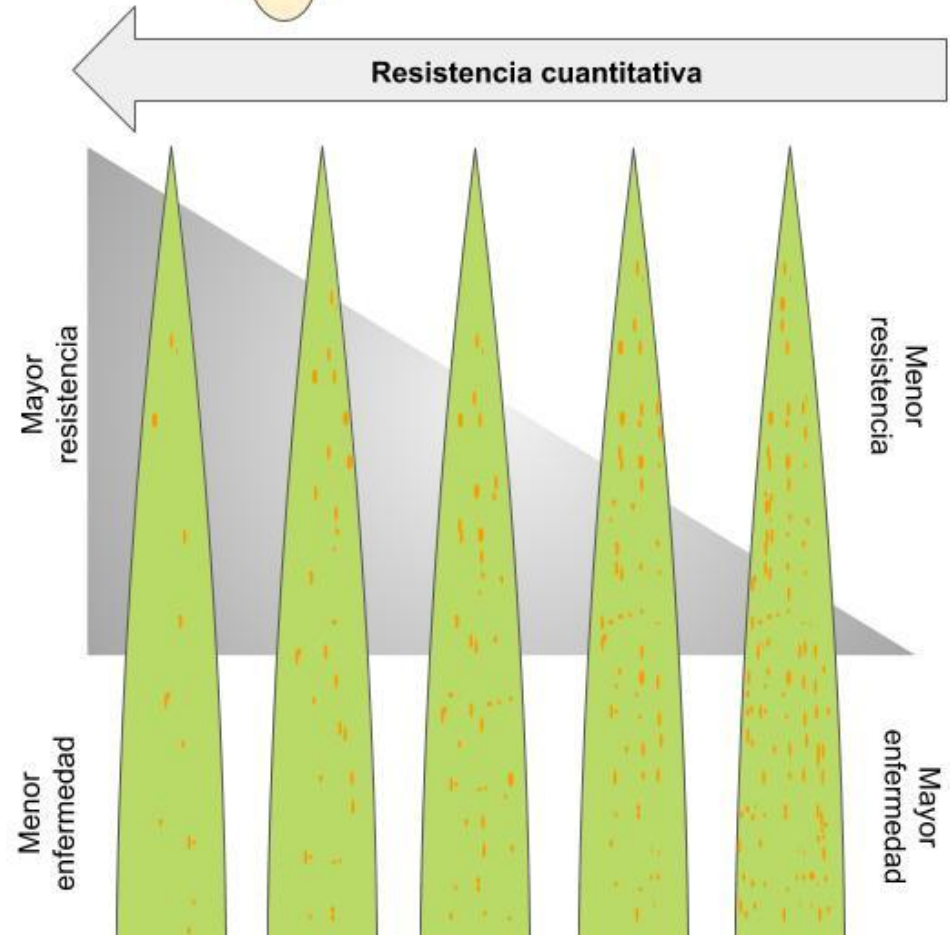
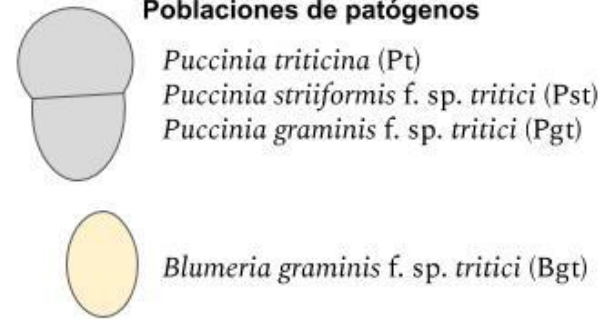
## Resistencia vertical

Razas fisiológicas de *Puccinia triticina* \*

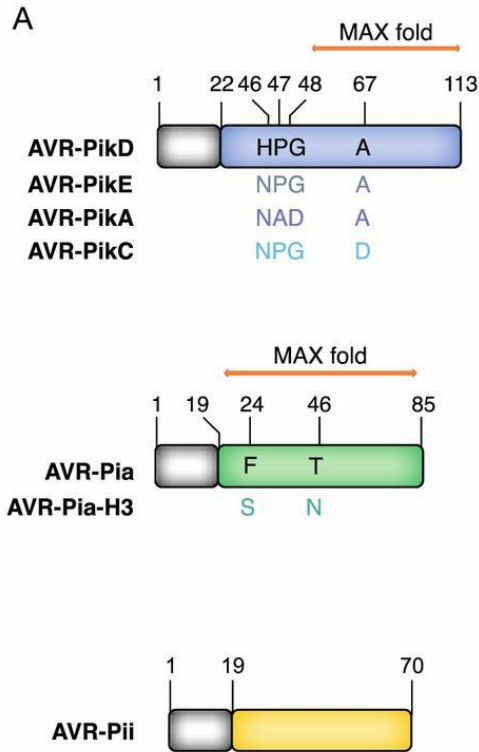


## Resistencia horizontal

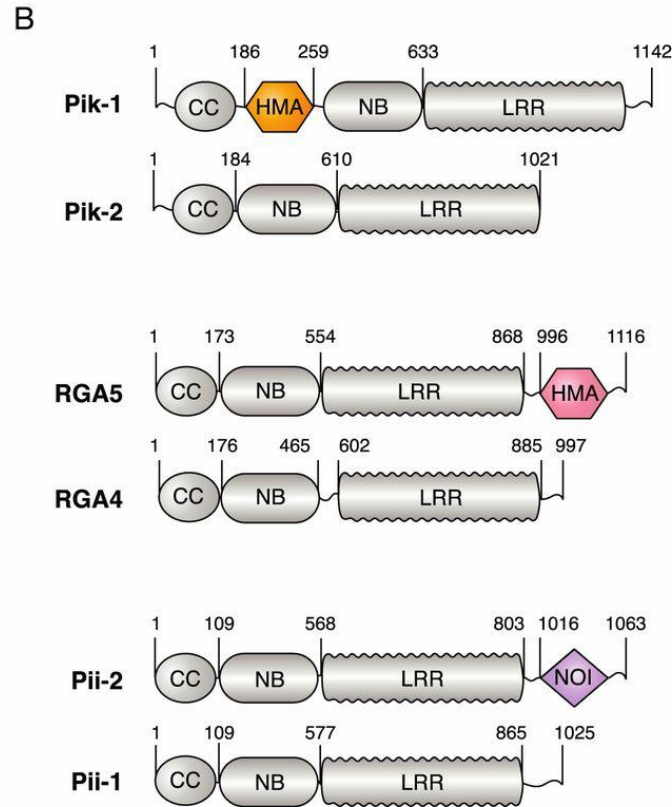
Poblaciones de patógenos



## Effectors

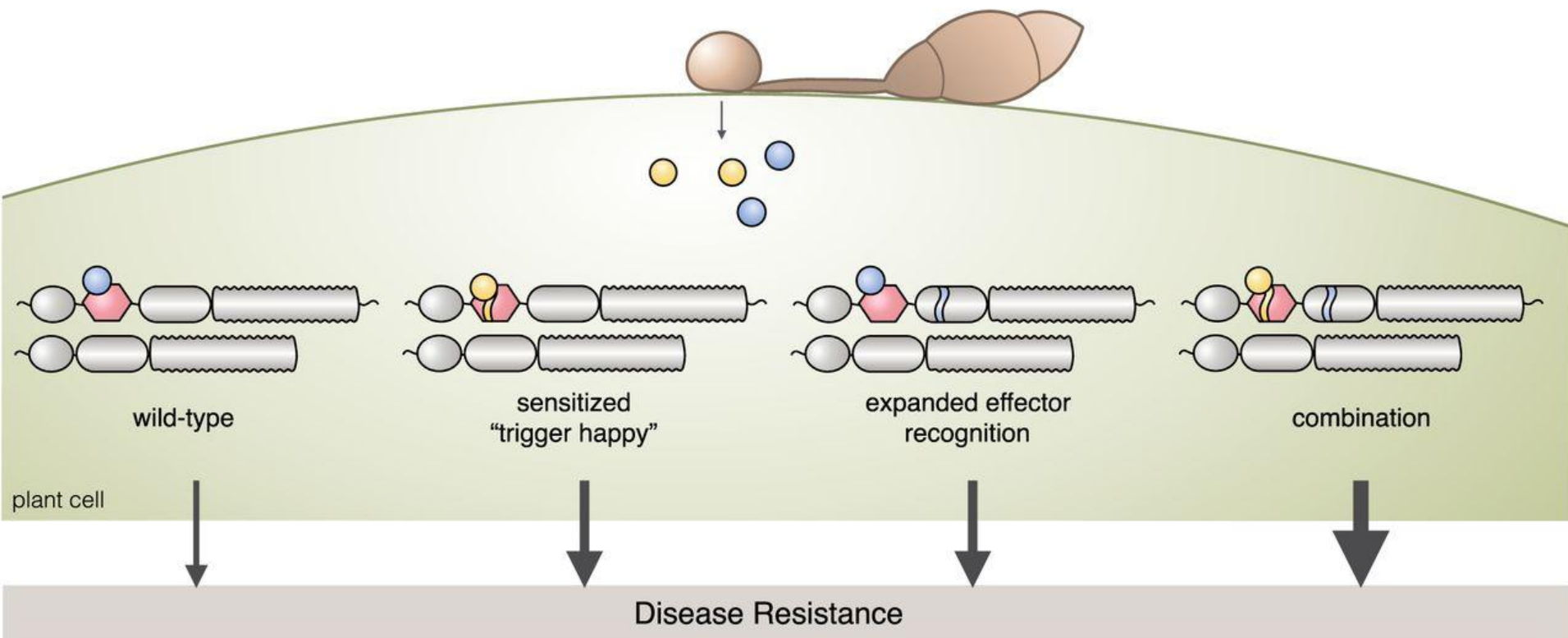


## Nucleotide-binding domain and leucine-rich repeat-containing (NLR) proteins



Three little effectors and corresponding plant NLRs.

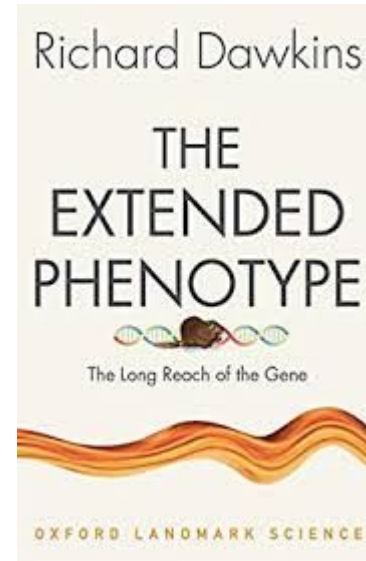
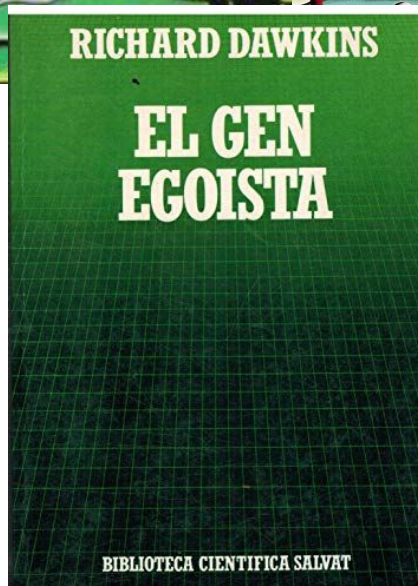
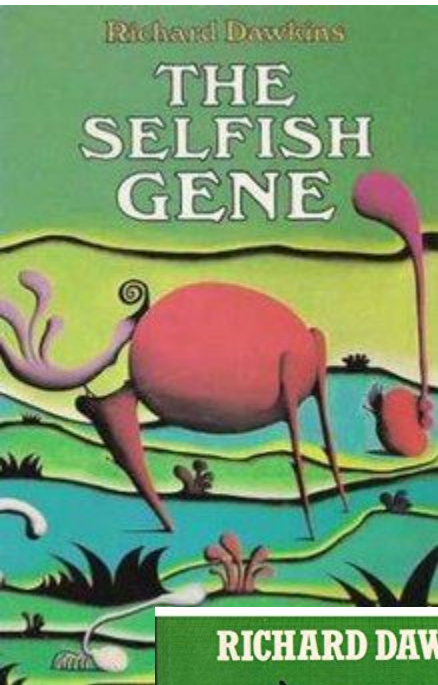
(A) The alleles of the *Magnaporthe oryzae* effectors AVR-Pik, AVR-Pia, and AVR-Pii showing the position of polymorphic residues. The effector domain is shown in color, while the signal peptide is in grey. The conserved MAX fold in AVR-Pik and AVR-Pia is displayed as an orange arrow. (B) Rice Pik, Pia (RGA5/ RGA4), and Pii NLRs highlighting the position of integrated HMA (hexagon) and AvrRpt cleavage/NOI (diamond) domains in the classical plant NLR architecture (CC, coiled coil; NB, Nucleotide-binding; LRR, leucine rich repeat domain).



### Strategies for improving NLR immune receptors.

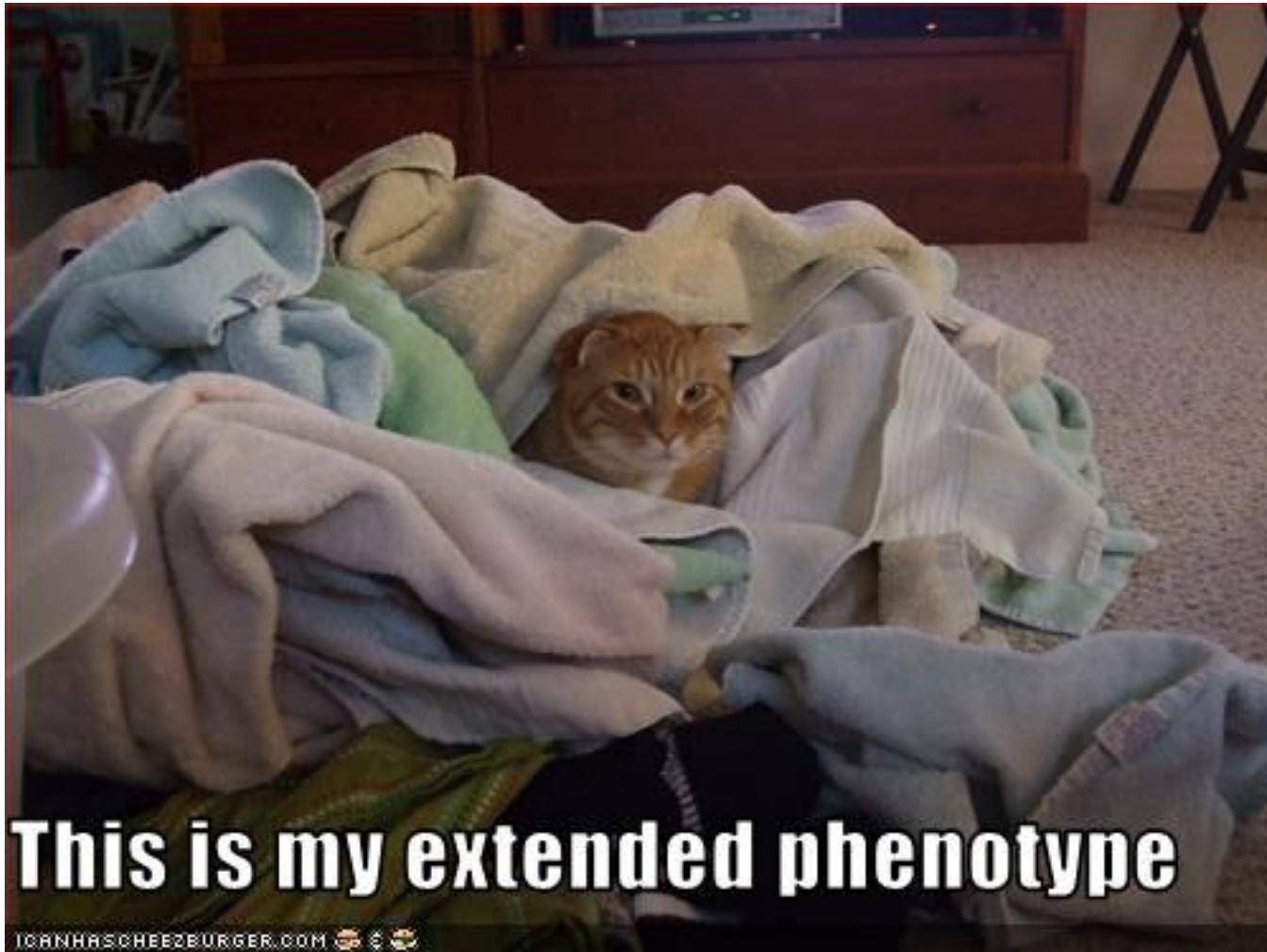
Sensitized NLR mutants are "trigger-happy," having a lower activation threshold, whereas mutants with altered effector binding respond to a wider spectrum of effectors. We hypothesize that combining the two classes of mutants would result in more effective levels of disease resistance (illustrated by the thickness of the arrow).

Los genes vir/avir son una representación de un fenómeno biológico y social que vives todos los días



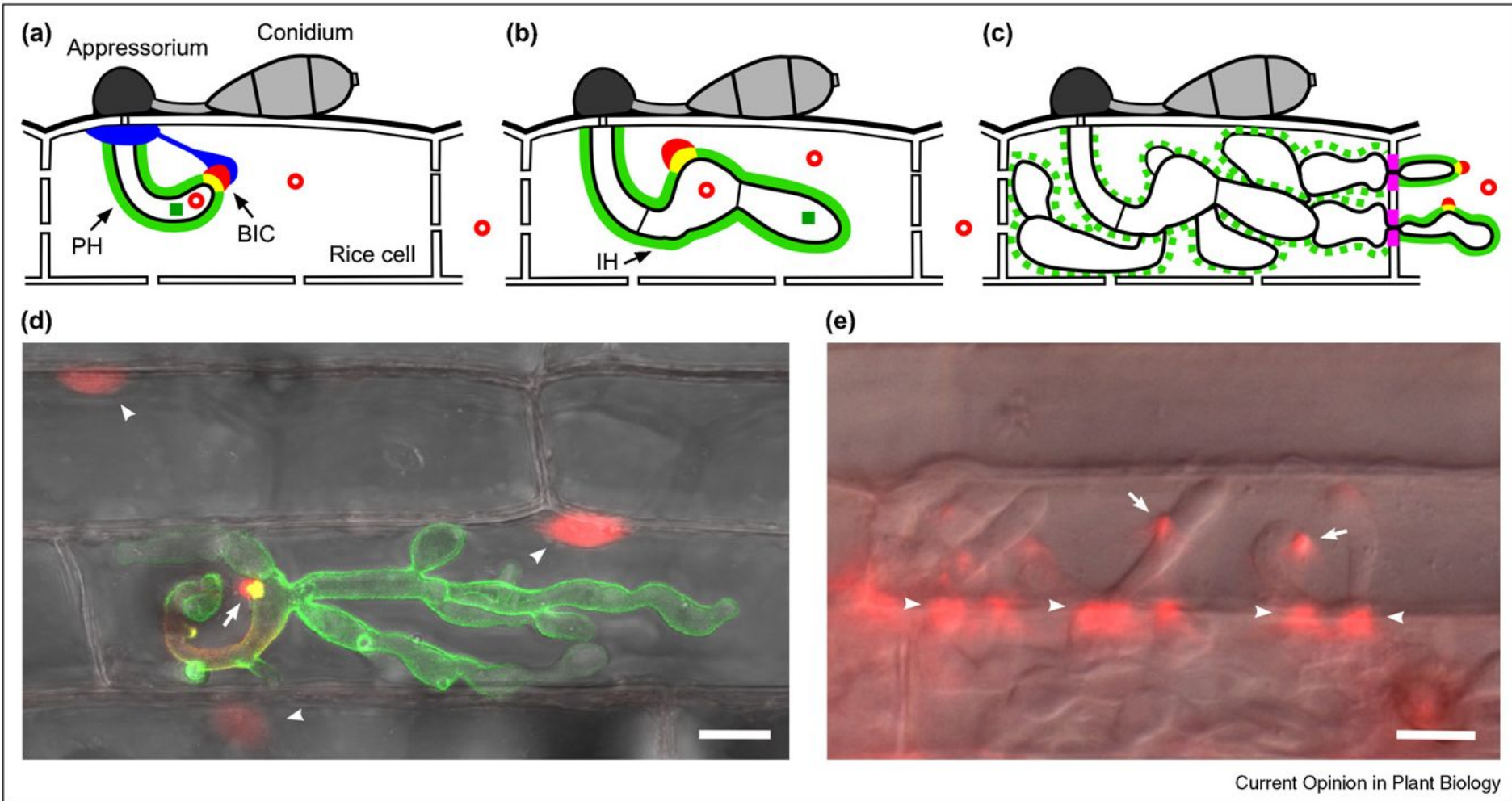


# El fenotipo extendido (o extenso)



Los efectores (codificados por los genes de virulencia o avirulencia) son el fenotipo extendido del patógeno

# Genes avir/vir en acción: Fenotipo extendido



Current Opinion in Plant Biology

Muchas gracias

Todas las preguntas son bienvenidas

