

Fusarium wilt, disease incidence was highest at 45% soil moisture and absent at 15% soil moisture, indicating that pathogen activity and host invasion require an intermediate-to-high soil moisture range rather than dry substrates (Figure 1). Fruit pathogens show a similarly broad but humidity-responsive capacity for infection, because *Phytophthora capsici* formed lesions across all tested relative humidities, yet water-soaking and pathogen growth increased as humidity increased, demonstrating that elevated atmospheric moisture can intensify symptom expansion even when infection is already possible.

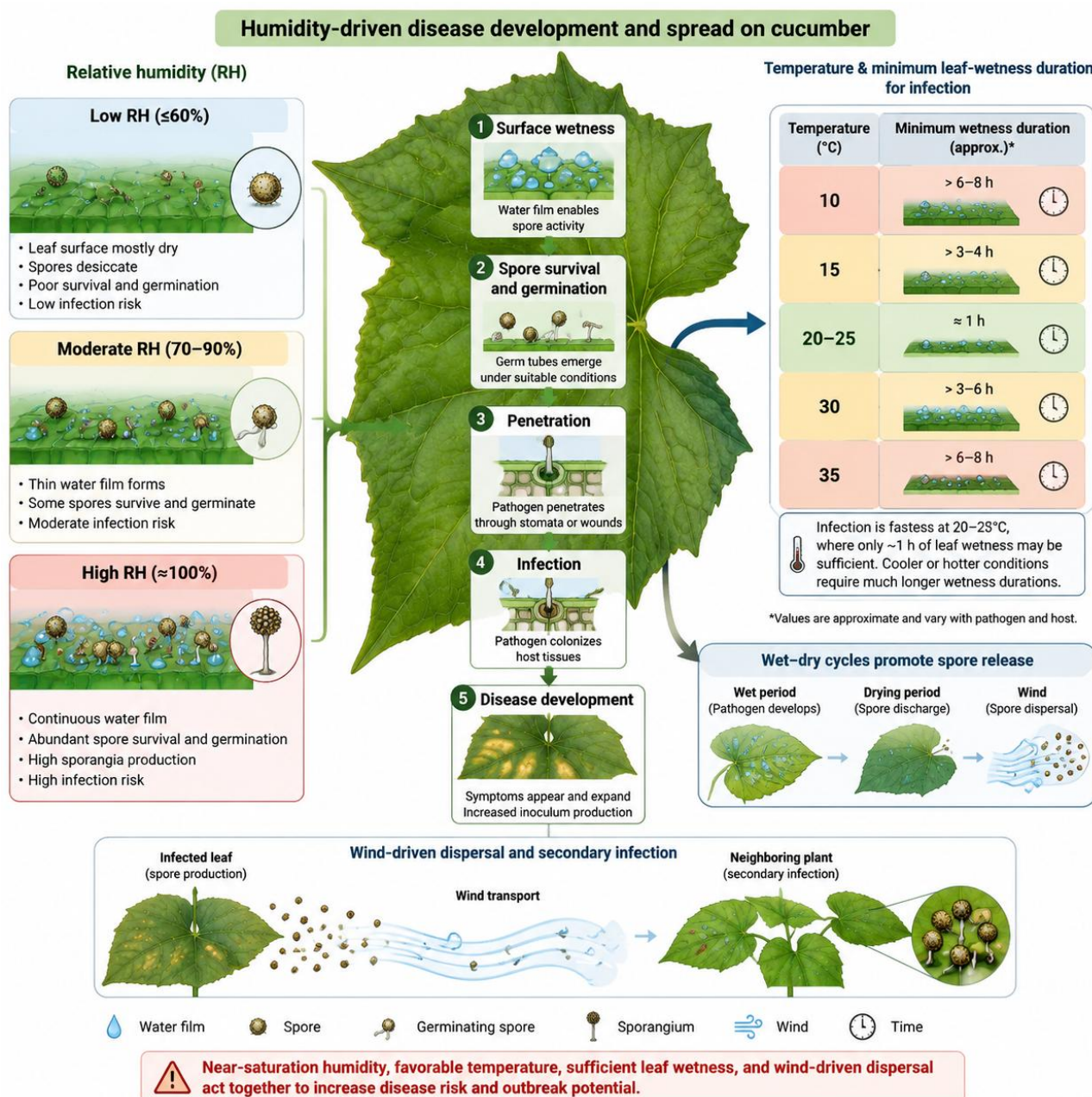


Figure 1 Conceptual framework illustrating the effects of relative humidity, leaf wetness duration, temperature, and wind-driven dispersal on cucumber pathogen survival, germination, infection, and disease development

3.2 Humidity-mediated changes in plant-pathogen interactions

Humidity conditions modify plant-pathogen interactions not only by favoring the pathogen, but also by changing cucumber physiology and defense capacity. Under low temperature plus 95% humidity, young cucumber plants showed reduced photosynthesis, chlorophyll content, and biomass together with increased oxidative stress markers, indicating that humid stress environments can weaken host performance at the same time that they favor disease development. Later work similarly showed that low temperature and high relative humidity reduced