

Plant Pathology Seminar Series



“Impact and Maintenance of Specialist Strategies in the Legume-Rhizobia Mutualism”

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Interspecific mutualisms are both ecologically vital and common, appearing across all domains of life¹. Mutualisms come in many forms, and these partnerships provide a fitness advantage to the species involved, making mutualism maintenance advantageous. When maintained over time mutualisms cause partners to evolve in response to one another². One would expect that coevolution would lead to a narrow partner range, but in fact many mutualisms lack specificity¹. This generalist strategy is favored as it offers each partner stability. When organisms can utilize more than one partner, as generalists do, they are shielded from harm resulting from environmental biotic shifts⁷.

Though generalist strategies are more common, some mutualisms are highly specialized. Specialists enjoy use more efficient resource use and less interspecific competition¹². However, fewer partners result in stiffer negotiations between host and microbes and introduce the potential for non-cooperative partners to emerge, potentially threatening the mutualism^{8,3}. Take for example the Legume-Rhizobia partnership, wherein legumes trade carbon for fixed nitrogen from the soil diazotrophs. In this mutualism both partners have a distinct host range^{5,9}. Partnership is initiated when free-living rhizobia induce *Nod* genes upon exposure to root secreted flavonoids, synthesizing the Nod Factor and inducing nodulation⁴. Host recognition is dictated by chemical variation of the Nod Factor⁶. The plant begins to form root nodules when the Nod Factor is sensed, but the plant cannot determine ahead of time if a rhizobium will be an effective partner, exposing the plant to “free riders”¹⁰.

To study how non-cooperative partners impact the maintenance of symbiotic selectivity, researchers in the Simms lab modeled interactions between a host and two nodules when fixation ability was manipulated. They determined that key factors in maintaining mutualism were the “stubbornness” of each partner – how long they held out in a war of attrition – and the number of outside partner options available¹¹. Researchers concluded that the interplay of plant sanctions, partner fidelity feedback, and partner negotiations are vital components of maintaining the legume-rhizobia symbiosis.

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