Rathayibacter toxicus: A Dual Kingdom Pathogen Threatening Plants, Animals and Humans

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Major Points

- Bacterium (*R. toxicus*) needs a nematode vector
- Potential nematodes vectors are in the U.S.
- Plant hosts: many , esp. field grasses and cereals, incl. U.S.
- Multiple corynetoxins produced
- No immunity

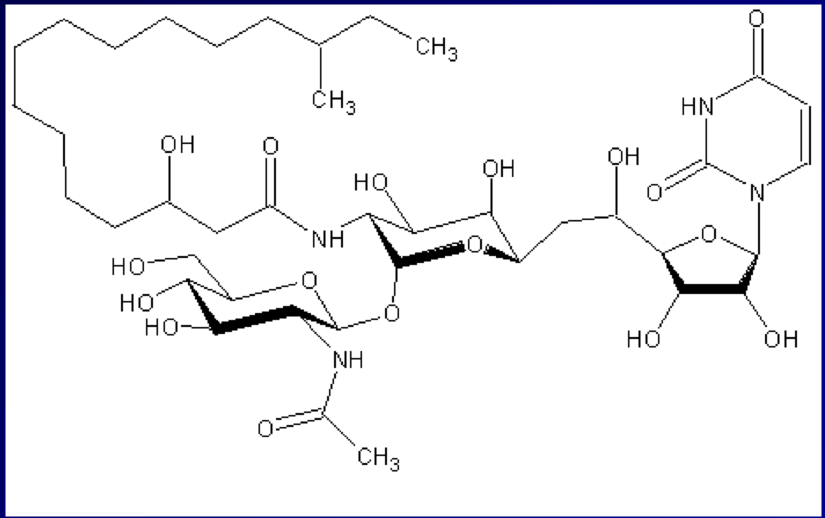
Major Reference

- Recovery Plan for *Rathayibacter* Poisonng caused by *Rathayibacter toxicus* (syn. *Clavibacter toxicus*) , 2015, 28 pp.
- National Plant Disease Recovery system: Plant Diseases that Threaten U.S. Agriculture
- Select Agent
- USDA: www. ars. usda.gov

Corynetoxins Produced by *R. toxicus*

- Members of tunicamycin family of antibiotics
- Glycolipid sidechains – 16 variations
- Heat stable
- Highly toxic (3-6 mg/kg/ body weight)
- Cumulative effect
- No immunity
- No effective vaccine to date

Corynetoxin Structure



Corynetoxin H17a, one of the major components of the *Rathayibacter toxicus* corynetoxins (Eckardt, 1983).

Biological Safety, 5th ed., ASM

- Biological Safety Considerations for Plant Pathogens and Plant-associated Microorganisms of Significance to Human Health
- Anne Vidaver, Sue Tolin and Patricia Lambrecht
- In press (2016)

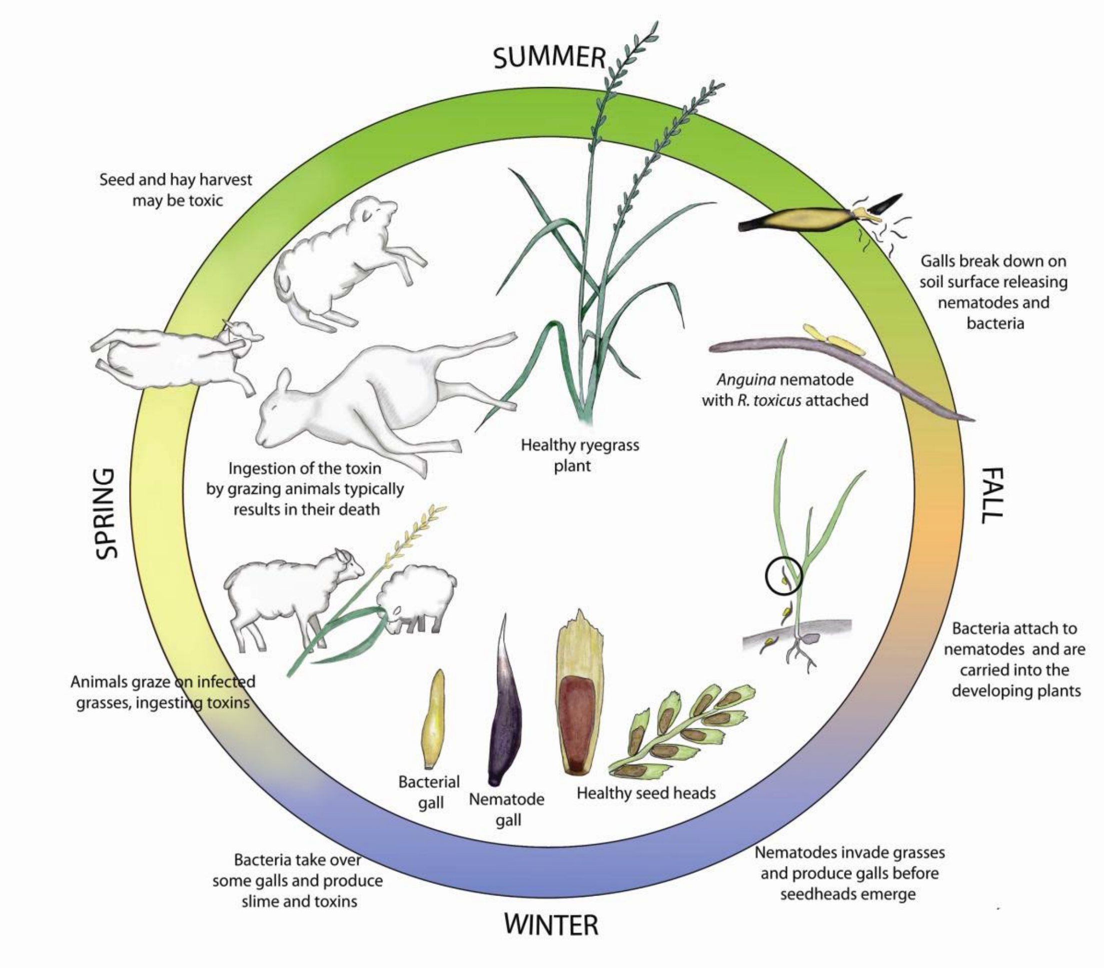
Potential Nematode Vectors in U.S.

- *Anguina agrostis*: Bentgrass seed gall nematode
- *A. pacificae*: Pacific shoot gall nematode. Host *Poa annua*
- *A. tritici*: Wheat seed gall nematode. (Not reported in U.S. since 1975)
- *A. agropyronifloris*: Host western wheatgrass (A*gropyron smithii*)

U.S. Susceptibility

- Cattle - 95 million
- Sheep - 6 million
- Horses - 9 million: race horses most valuable
- Bison thousands
- Other grazing animals
- Humans? (contaminated cereals)

The Annual Life Cycle of the Bacterium Causing Rathayibacter Poisoning



This diagram is not drawn to scale. Not all animals consuming infected grasses die as a result.

Challenges

- The bacterium is not vector (nematode) specific
- Host plants: many
- Gumming, slime in plant seed heads (not always)
- Can be undetected for years
- The mechanism(s) underlying the production of toxins is unknown. Toxins are not produced in vitro
- Survival of vector, bacterium: long term, years

Veterinary Challenges

- Neurological symptoms can mimic other diseases
- Animals do not develop immunity
- Treatments limited
- Toxins transmitted in contaminated hay/grass
- Primarily in Australia: also Japan, S. Africa

Management Practices

- Crop rotation
- Rotation among grazed pastures
- Harvesting hay before toxin production
- Inspection
- Use of certified seed free of *R. toxicus*

Recommendations

- Quarantine for hay products/forage grass seeds
- Reliable, rapid I.D. tests for *R. toxicus*, vectors and toxins
- Surveys/monitoring of grasses
- Education: plant & animal personnel, materials, workshops

Needs

- Assess biochemical and genetic mechanisms of toxin production
- Role of toxins in ecology
- Assess genetic variability in pathogen, esp. toxin
- Biocontrol of pathogen; vector
- Plants: breeding for resistance to toxins
- Pasture management for U.S.
- Animals: protections mechanisms, incl. potential vaccine(s)

U.S. Situation

- Susceptible grasses/crops
- Crop surveys: low frequency, limitations
- Potential nematode vectors
- Related pathogens, e.g. *R. rathayi* in Oregon
- Trade, transport, weather dissemination

Next Steps

Interdisciplinary workshop/discussion on current status

Prioritize research, education, outreach programs

Marvel at complexity of a natural disease cycle