Recovery Plan for Rathayibacter poisoning

*R. toxicus*: a cross-domain pathogen

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Life cycle

**SUMMER**
- Healthy ryegrass plant
- Anguina nematode with R. toxicus attached
- Galls break down on soil surface releasing nematodes and bacteria

**SPRING**
- Ingestion of the toxin by grazing animals typically results in their death
- Animals graze on infected grasses, ingesting toxins

**WINTER**
- Nematodes invade grasses and produce galls before seedheads emerge
- Bacteria take over some galls and produce slime and toxins

**FALL**
- Bacteria attach to nematodes and are carried into the developing plants
Nematode Anguina spp serve as a vector for R. toxicus infection

Microphotograph of Anguina sp. nematode juvenile (J2) [photo courtesy of Dr. T.O. Powers]

Nematode Anguina funesta juveniles with R. toxicus (seen as dark dots on the surface of nematodes) adhered to the cuticle [photo from Stynes and Bird, Phytopathology, 1982, 72:336-46]
Ingestion of the toxin by grazing animals results in their death

Dead sheep after eating infected annual ryegrass (Lolium rigidum) in South Australia
[photo: J.W. Finnie, Inst. of Medical and Veterinary Science (IMVS), South Australia]
Affected plants

Symptoms of gumming disease (R. rathayi) in Maryland and Oregon [photos: N.W. Schaad (left) and M. L. Putnam (right)].
Affected seeds

Healthy *Lolium rigidum* seed (left), *Anguina funesta* gall (center), and *Rathayibacter toxicus* colonized nematode gall (right) [photo: I. Riley]
Challenges

- Vector (nematode) not specific
- Host plant: primarily pasture grasses
- Gumming, slime in plant seed heads
- Toxins affecting all grazing animals produced: multiple
- Can be undetected for years
- 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
U.S. Situation

- Susceptible grasses
- Potential nematode vectors
- Related pathogens, e.g. *R. rathayi* in Oregon and Maryland
- Trade, transport, weather dissemination
Management practices

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

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

- Rapid, accurate diagnostic tools for *R. toxicus* and nematode vectors
- Toxins: role in ecology; genetic basis
- Nematode control
- Plants: breeding for resistance to toxin; pasture management for U.S.
- Animals: protection mechanisms, incl. vaccine(s)