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Prioritizing High Risk Pathogens for the National Plant Disease Recovery System

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(or)

So many pathogens; so little time!

Pathogen prioritization criteria (D. Luster)

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- Potential of pathogen to establish and spread in the US
- Pathogen is amenable to production and delivery
- The pathway for entry
- High, direct trade-related economic effect
- High social or psychological shock value
- Public cost of eradication / management
- Rating scale 0-3 (1 = low; 3 = high; 0 = NEI)

Pathogen prioritization criteria (R. Bulluck)

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- Bioterrorism-Based Organism Pest Risk Assessments (BOPRA's). Pathway risk analysis; consequences of introduction; likelihood of introduction, etc.
- Combined Bioterrorism Index (CBTI). Based on bioterrorism criteria, i.e., ease of culturing; ease of spread, ease of infection, survivability, etc.

Pathogen Prioritization Criteria

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Select pathogens from the "LISTS"

- Exotic pathogens and/or remerging pathogens
- Threat agent list: approx. 6 - 8
- Cooperative Agricultural Pest Survey (CAPS) list - 140 pests
- Bio-warfare and bio-terrorism pathogen lists - several dozen
- Mycotoxin-producing microbes (Aflatoxins, fumonisins, toxigenic molds and mushrooms)
- Etc.

Pathogen prioritization criteria

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Prioritize based on value of the host

- Top food and fiber crops (corn, wheat, soybean, sorghum, rice, potatoes, sugarcane, cotton, etc.)
- Forests and landscape tree pathogens
- Vegetables, Ornamentals, Fruits

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All of these “methods” are valid and would result in a scientifically-sound group of plant pathogens worthy of a recovery plan.

The problem is that they would also generate a large number of pathogens and we would be back to where we started - how to whittle down the list to a manageable number?

The "Martyn Method?"

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- Simple in theory
- Generic in principle

1. Utilize one or more of the previous methods to generate a "worthy and respectable list of high consequence plant pathogens".
2. Pare it down by selecting pathogens that can act as generic models for other similar pathogens.

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- What is a recovery plan and what is it not?

1. A recovery plan should not be an all-encompassing treatise on everything known about a particular pathogen and disease.

2. *I do think it should focus on how the agriculture sector would approach and deal with a new introduction.*

For example, would the introduction result in a quarantine and eradication program - or not?

The response to the introduction of Karnal bunt was much different than the introduction of soybean rust. One was a quarantine and eradication strategy, the other was not.

For example:

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- Select pathogens whose recovery plans could, with little modification, be quickly modified to fit a new pathogen. Have them based on the procedures likely to be employed after detection as opposed to crop, pathogen taxa, etc.
  - Since a recovery plan for *stem rust* and *stripe rust* has been prepared, could it be used as a 'model' for other airborne, foliar, pathogens on high value field crops?
  - Could the stem rust plan be adapted quickly for a new rust of wheat, barley, corn, soybean, etc. How different would the recovery plan for wheat rust be from corn rust? Would the same group of registered fungicides be applicable? Would mitigation strategies be similar?

For example…

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- What do plum pox virus, HLB, Pierce's disease, and multiple other viruses and fastidious vascular bacteria have in common?
- They all would have similar responses to their detection and management…
  - They would all invoke regulatory action
  - Quarantine and containment
  - Destruction of infected and perimeter trees/vines
  - Vector monitoring and management
  - Extensive surveys of nursery and retail stock
  - Likely compensation plans
  - Etc.

For example…

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- What do soybean rust and TTKS (Ug99) wheat stem rust have in common.
- They would both result in similar federal actions…
  - No likely regulatory action
  - No containment
  - No massive eradication effort
  - Regional / National surveys
  - Early warning system - sentential plots
  - Similar protective and eradicative fungicides, sec 18
  - Not likely to have a grower compensation plan
  - Etc.

For example…

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- You might even make a case for the commonality of potato wart and potato cyst…
  - Both are soilborne
  - Both produce long-lived overseasoning propagules
  - Both would result in extensive on-farm soil sampling
  - Both would have trade embargo / export issues
  - Both would have similar management schemes (quarantine, certified ‘seed’, soil fumigation, long rotations, sanitation practices, etc.)
- So why couldn’t they have similar recovery plans? Vastly different pathogens but similar responses.

So the goal is to…

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- Select pathogens whose basic biology and epidemiology are representative of a much larger and diverse group of pathogens but that would likely result in the same or very similar general response actions.
- Prepare recovery plans for a few, including as much generic information as possible (along with the specific info for the target pathogen) so that when the newest '*pathogen de jour*' comes along, there is a template plan ready to build on.

Summary

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- Two-step process
  - Prepare a "worthy list of respectable plant pathogens" by whatever means…
  - Pare the list to a select few that can serve as generic models for at least much of the mitigation and recovery parts of the plans.
  - Ideally, new plans could be prepared quickly for new pathogens by filling in some basic information.

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- Some of the generic parts could be:
  - » Pathway of entry (airborne, commerce and trade, seed, personal and commercial contamination, etc.)
  - » Means of dispersal and dissemination (insects, wind, rain/storms, seed/propagative plant parts; commerce and trade, etc.)
  - » Pathogen biology (taxa, survival, vectors, environmental parameters, etc.)
  - » Response (Quarantines and containment, embargos, regulatory and/or legal issues, etc.)
  - » Mitigation (Eradication, chemical treatment, sanitation, resistance, etc.)
- The more of these types of things in common, the better.

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- *Ug99 strain of Pgt (race TTKS)* - Would it be a regulatory or phytosanitary pathogen? How much different would it be from soybean rust? Are effective fungicides available; e.g. would the same chemistries used for SBR work TTKS? Is germplasm being evaluated? Would sentential plots be established?
- *P. kernovia / P. ramorum* - What would be done differently than what's being currently done?)

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- The argument to this idea will likely be that "it won't work!"
- But, a recovery plan is not a monograph on a select disease. It is (or should be) a plan for how we would deal with the introduction and potential establishment of a high-consequence pathogen of an important economic host!
- How different would the mitigation and recovery from Pierce's disease of grape be from citrus canker and/or citrus greening, or perhaps even plum pox!
- Wouldn't each of these diseases be handled initially in a similar way? Quarantine, containment procedures (survey of commercial groves and nurseries), eradication (destruction of infected and perimeter trees/vines), vector monitoring and control, germplasm evaluation, compensation, consumer education, etc.)

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- So the goal is to identify a handful of potential high consequence pathogens that can serve a templates for the many more waiting to get in.
- Ideally, new plans could be prepared quickly, filling in some of the specifics of the new pathogen.

For example:

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- If plum pox virus (or similar virus) is a concern, could it be used as model for other insect-transmitted viruses on other major fruit crops (citrus, etc.?) Could it be used for insect-transmitted pathogens in general?
- If citrus greening is a concern, can its plan be used as a model for insect-transmitted, wind-blown rain dispersed, fastidious vascular bacterial pathogens (*Liberibacter; Xylella, Candidatus*) of high value crops? (fruit and nut crops- apples, pears, almonds, grapes; landscape trees and shrubs, etc.)