Adaptation of Forests to Climate Change: Building Capacity to Meet the Challenges

Idea is to put together one big grant----for submission to FFAR or whoever after development by the partners involved.

Why Focus on Forests? https://www.iucn.org/resources/issues-briefs/forests-and-climate-change----below taken from this reference

- **Forests help stabilise the climate.** They regulate ecosystems, protect biodiversity, play an integral part in the carbon cycle, support livelihoods, and can help drive sustainable growth.
- To maximise the climate benefits of forests, we must **keep more** forest landscapes intact, **manage them more sustainably**, and **restore more** of those landscapes which we have lost.
- Halting the loss and degradation of natural systems and promoting their restoration have the **potential to contribute over one-third of the total climate change mitigation** scientists say is required by 2030.
- **Restoring 350 million hectares** of degraded land in line with the Bonn Challenge could sequester up to **1.7 gigatonnes of carbon dioxide equivalent annually**.

Area Focus of a new ambitious Proposal: The mixed hardwood forests of the US

Species focus of this proposal: Oak, Ash, Chestnut, Hybrid Poplar as a model system

Disease focus:

- Oak---sudden death (Phytophthera ramorum); Phytophthera root rot (oomycete)? Amillaria root rot (fungal)
- Ash---ash borer
- Chestnut---blight, Phytophthera root rot
- Poplar---poplar borer? Amillaria root rot (fungal); Phytophthera? Canker (cytospora)----needs a lot of thought

Critical research goals:

- Genomics----completing sequence of genomes and annotation of reference genomes; resequencing of trees from diversity orchards; association studies for key traits such as disease/insect resistant loci, etc etc
- New tools for breeders---especially early flowering fast plants—
- Preserving diversity to combat rising temperatures----identifying and preserving diversity from south to north in conservation orchards (tolerance to higher temps probably involves many genes and hard to select for---such diversity orchards may provide varying ranges

Received: Friday, July 23, 2021

of temp tolerance selected naturally over a long time---could propose to confirm experimentally differences in temp tolerance between trees from Canada/Maine and those from Georgia/Alabama? TACF chapters might do a lot of this? Are there similar volunteer Groups for oak, and ash? Are there any such diversity collections for oak/ash?

- Clonal propagation----breaking barriers to clonal propagation of stem cuttings; exploring new avenues for creating embryo cultures from somatic tissues;
- Developing and optimizing of gene editing systems for hardwoods; optimizing protocols for insertion of constructs into focus plants; optimizing editing especially for homologous recombination events;
- Identify key genes to target for gene editing (disease/insect resistance key priority).
- Development of faster, more accurate assays to measure resistance to specific diseases (with focus on Phytophthera and canker diseases?). what about biomarkers?
- A clear plan for how to move forward assuming the OXO gene even is deregulated in Darling;
- USDA. Sudden Oak disease; Biocontrol of plant borers;

Is there a way to make this more focused? Any common mechanisms involved in Phytophthera root rot, and sudden oak death (Phytoph ramorum) so we could focus the research? Could OXO work for other cankers? Biocontrol for various plant borers?

Funding partners:

TACF with funds from members but mostly from a few key philanthropists—we need to get at least a few million dollars? Also provides in kind services from its chapter members

Foundations promoting climate change---EDF, Packard, Hewett, Moore, Bloomberg; Sierra Club?, any that support work on ash borer or oak diseases?

USDA/Forest Service—also involve the NFGEL—Natl Forest Genetics Lab; Pacific Southwest lab for sudden oak death

Corteva to provide in kind scientific advice on gene delivery and gene editing; fast plants

FFAR to match part or all of above except USDA—see FFAR.org (I am on the BOD)

Possible scientific collaborators on the grant:

TACF takes the lead—Jared/Sara//Kendra/Tom/new southern region person?? New scientist at meadowview—what could he do? Lisa is lead overall with idea we would hire a lead if funded?

Steve Strauss oregon and Gerry Tuscan (oak ridge) on poplar---what can we learn from poplar work? Can we test some ideas here faster? Is this a good idea or not?

Bill Powell and team—SUNY ESF----Oxo work and gene editing

Corteva---todd Jones-----transformation/gene editing/fast plants

Scott Merkel—U Ga---optimizing embryogenesis; diversity for the OXO gene

*** at Clemson—the lady trying to optimize stem explants for propagation; the Canadian?

*** at VA Tech----landscape genomics

Hudson Alpha---for gene sequencing/annotation

Pier-luigi Bonello----Plant Path Ohio State-----biomarkers of disease resistance in trees; mechanisms of disease resistance in trees (ash borer included); anybody know this guy? He looks interesting!! https://plantpath.osu.edu/our-people/pierluigi-enrico-bonello

Kim/Sara and all----should we propose some model reforestation efforts now? Mixed hardwoods vs monocultures?

Others???