Quantifying the impact of pine decline in the southeastern United States

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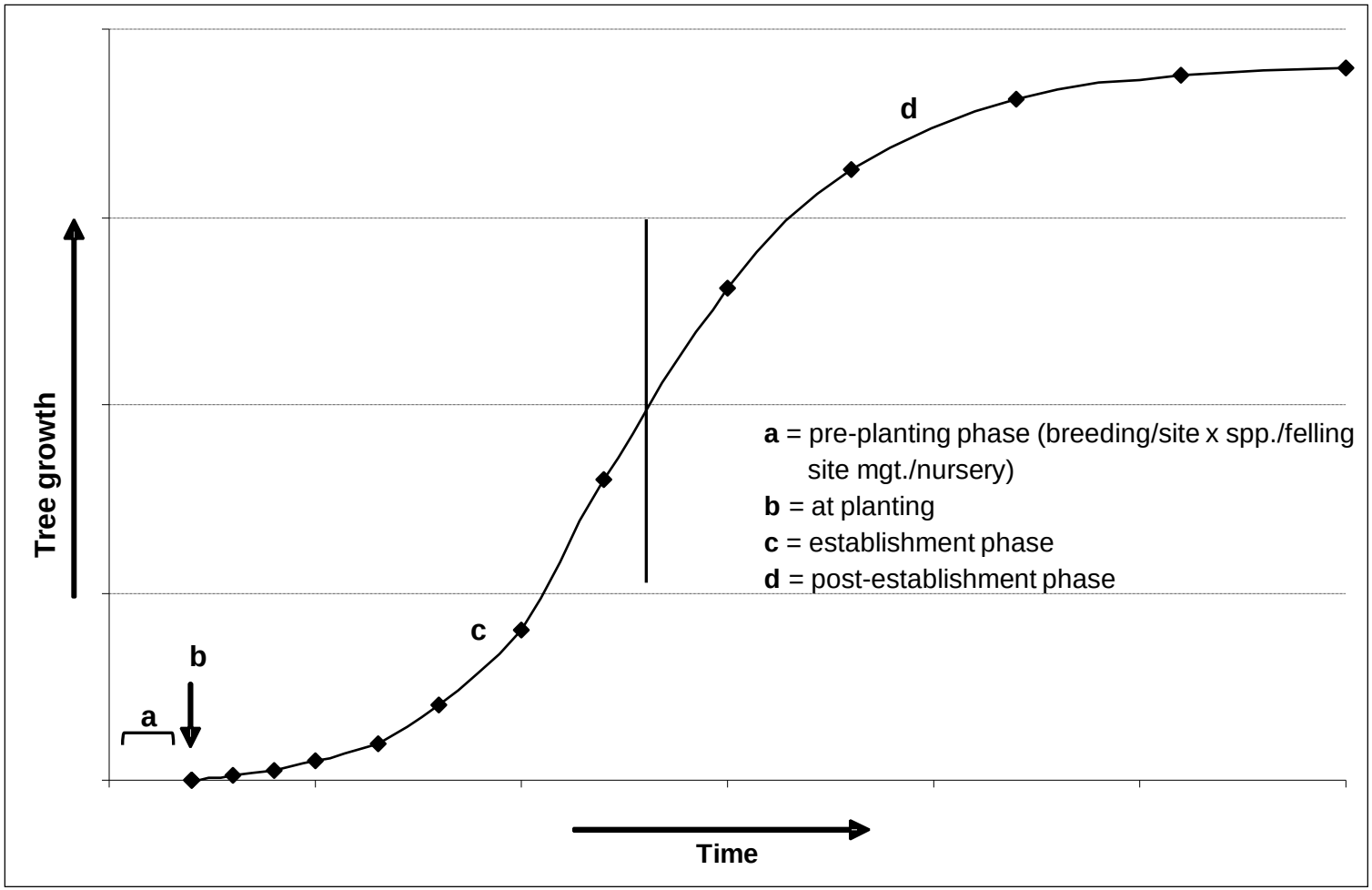
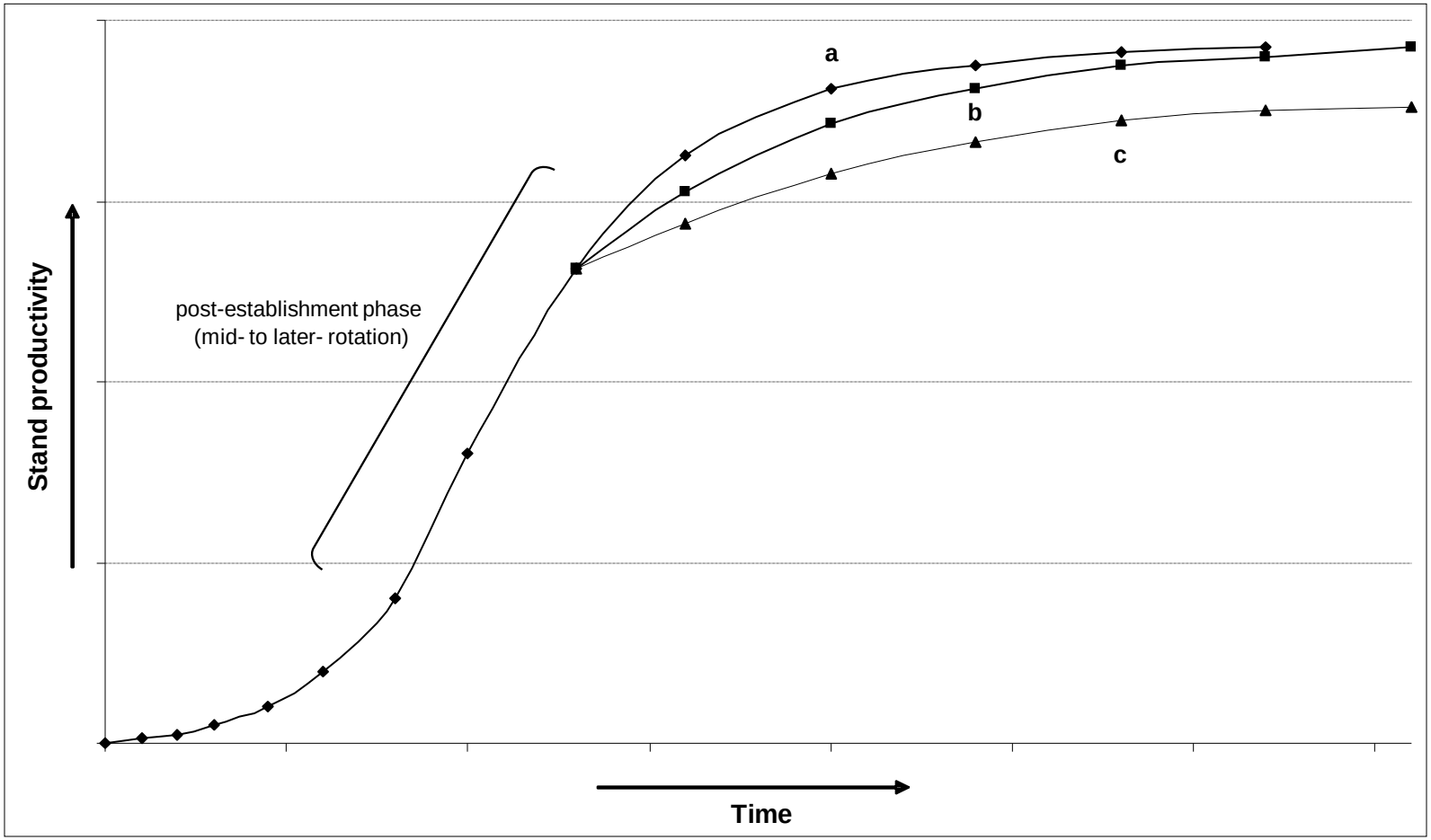
Introduction

The sustainability and profitability of these industrial wood plantations relies on optimal tree growth, however, pests and pathogens into these forest ecosystems results in significant economic impacts that require management response.

Understanding the impact of pests and/or diseases on forest productivity, and the development of any control measures is not only critical, but also technically challenging.

Although the majority of research focuses on unique aspects that can be quantified, the actual impacts caused by pests/diseases are difficult to quantify.


Tree growth
Time
a
b
c
d
a = pre-planting phase (breeding/site x spp./felling site mgt./nursery)
b = at planting
c = establishment phase
d = post-establishment phase


a
b
c
post-establishment phase
(mid- to later- rotation)
Stand productivity
Time

Objectives

1. Quantify the impact of fungal root infection on tree and plantation productivity.
2. Determine the threshold level of fungal root infection required to cause growth reductions and mortality of plantation trees.
3. Examine the role of fungal root infection on the water, nutrient, and carbon relations in plantation trees to determine why trees die (or suffer only growth losses) from the decline process (i.e. water/nutrient limitations, carbon allocations).
4. Determine the impact of fungal root infection on the behaviour of bark beetles and other pests within affected stands (i.e. does the decline process represent a positive feedback cycle?)

Predicted outcomes

Results from the project shall provide:

1. A correction factor, needed to account for losses from pine decline in growth/productivity models.
2. The impact from fungal infection on tree physiology and functioning required for developing potential growth curative solutions and models for trees and stands already affected.
3. The levels of infection that are acceptable (minimal growth loss and low probability of mortality) and those that fall above the damage thresholds.
4. An understanding of tree-level infection levels and their potential for attracting beetle vectors and additional infection at both a tree and site level (positive feedback: infection attracts beetles, which facilitate more infection).

Methodology

1. Approximately 20 acres of thinned forest plantation with good vehicle and equipment access (following 1st thin), is required to undertake this proposed trial in order to provide adequate replication.
2. Multiple, large-scale, tree-level root inoculation experiments will be used to simulate the natural root infection process under semi-controlled conditions in the field.
3. Precise tree physiological condition (water, nutrients, carbon) and growth measurements prior to and post inoculation treatments.
4. Varying infection levels among treated trees shall assist in determining the threshold infection level necessary to cause significant losses in tree growth and thus productivity.
5. Beetle behaviour surrounding and within infected trees will be monitored both prior to- and post inoculation treatment in order to examine the reaction of disease vectors to infection.

Budget

	Item	Requested funding			
Year		2015	2016	2017	2018
Administration	Salary/PhD Student	$19,100	$19,100	$19,100	$19,100
	Benefits	$478	$478	$478	$478
Travel	Field travel	TBD	TBD	TBD	TBD
	Meeting attendance		$4,000	$4,000	$4,000
Supplies		$10,000	$8,000	$8,000	$8,000
Lab analyses		$3,350	$3,350	$3,350	$3,350
Equipment	Band dendrometers	$980			
	Climate station	$1,500			
	Plant canopy analyzer	$7,300			
	Digital root scanning system and software	$19,300			
Miscellaneous		$2,000	$2,000	$2,000	$2,000
Total		**$66,023**	**$38,944**	**$38,945**	**$38,946**
GRAND TOTAL FOR 4 YEARS		**$182,858**			