

Introduction

As part of the Pine Integrated Network: Education, Mitigation, and Adaptation Project (PINEMAP), a regionwide, three-tiered monitoring network was established to evaluate the effects of climate, soils, and management approaches on carbon sequestration rates in planted loblolly pine. An additional objective of this monitoring network includes the collection of regional baseline data on C, H₂O, and nutrient storage rates and fluxes, as well as their responses to climate and management.

Tier III of the monitoring network includes a series of four manipulative field experiments where fertilizer addition and throughfall reduction treatments were imposed. These sites are located at the edges of the loblolly pine natural range in McCurtain Co., OK; Taliaferro Co., GA; Buckingham Co., VA; and Taylor Co., FL (Figure 1). Together, these sites span the full temperature and precipitation range of loblolly pine in the southern United States.

Study Design

Treatments:

The Florida Tier III consists of a 2x2 factorial arrangement of treatments in a randomized complete block design with four replicates. The four treatments include:

- **Control (C):** no treatment
- **Fertilizer (F):** fertilizer addition (224.2 kg/ha N, 28.0 P, 56.0 K, micronutrients blend based on 1.1 B)
- **Rain throughfall exclusion (D):** 30% throughfall captured and diverted from plot via plastic gutters
- **Fertilizer + rain throughfall exclusion (FD):** combined F and D treatments

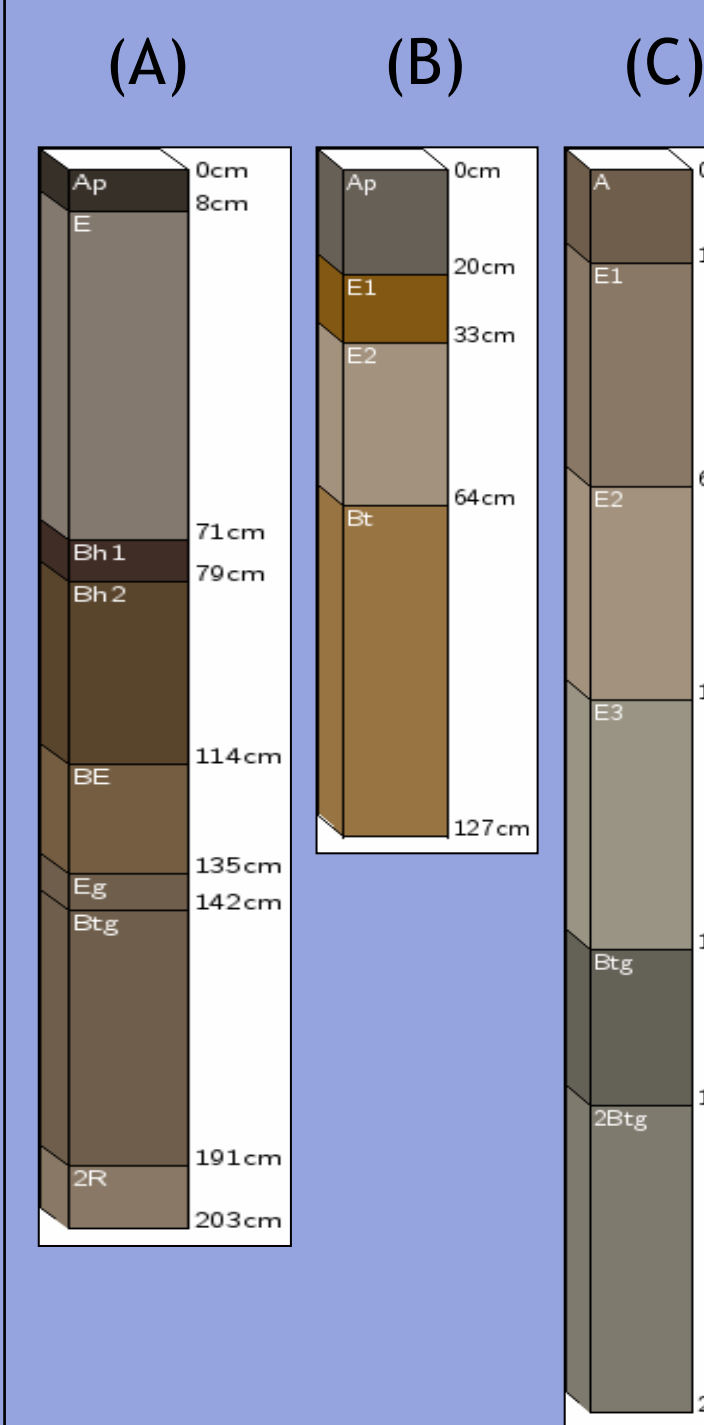
A 30% reduction in throughfall was selected based on maximum predicted variation in summertime precipitation resulting from climate change. This will allow us to examine the influence of climate on productivity by creating conditions likely outside the historical range of climate variability within the loblolly pine range. Additionally, with nutrient management common in planted pine systems, the above treatments will facilitate understanding of how reduced precipitation might affect pine productivity, and how fertilizer addition may alleviate these effects.

Plot size:

Each measurement plot is 14.6 x 16.8 m, surrounded by a 6.1 m buffer on all sides (treatment plot), followed by an additional 9.1 m buffer around the treatment plot (gross plot; Figure 2).

Site Characteristics

The Florida Tier III site is located west of Perry, FL in an operational loblolly pine stand managed by Foley Timber and Land Company (30.206, -83.870). The climate is characterized by a mean annual temperature of 19.4 °C and total annual precipitation of 144.7 cm. The soils are of the Melvina-Moriah-Lutterloh complex (Figure 3).



Melvina (A): Sandy, siliceous, thermic Oxyaquic Alorthods –somewhat poorly drained; negligible runoff; rapid permeability in the upper horizons and moderately slow permeability in the Btg horizon

Moriah (B): Loamy, siliceous, superactive, thermic Aquic Arenic Hapludalfs –somewhat poorly drained; very low runoff; rapid permeability in the A and E horizons and moderate to slow permeability in the Bt horizon

Lutterloh (C): Loamy, siliceous, subactive, thermic Grossarenic Paleudalfs –somewhat poorly drained; very low runoff; rapid permeability in the A horizon, moderate in the upper part of the argillic horizon, and slow to very slow in the lower part.

Figure 3. Typical soil profiles and descriptions based on the official series description provided by the USDA Natural Resources Conservation Service.

The stand was planted in the winter of 2003-2004 with a seed orchard mix of St. Joe 2nd generation open-pollinated stock at approximately 1.8 x 3.4 m spacing. At the time of rain throughfall structure installation (April 2012), the site was near canopy closure. Prior to installation, the site was mowed and treated with a tank mix of glyphosate (2% solution) and metsulfuron methyl (140 g/ha) to reduce understory competition and increase homogeneity across the site.

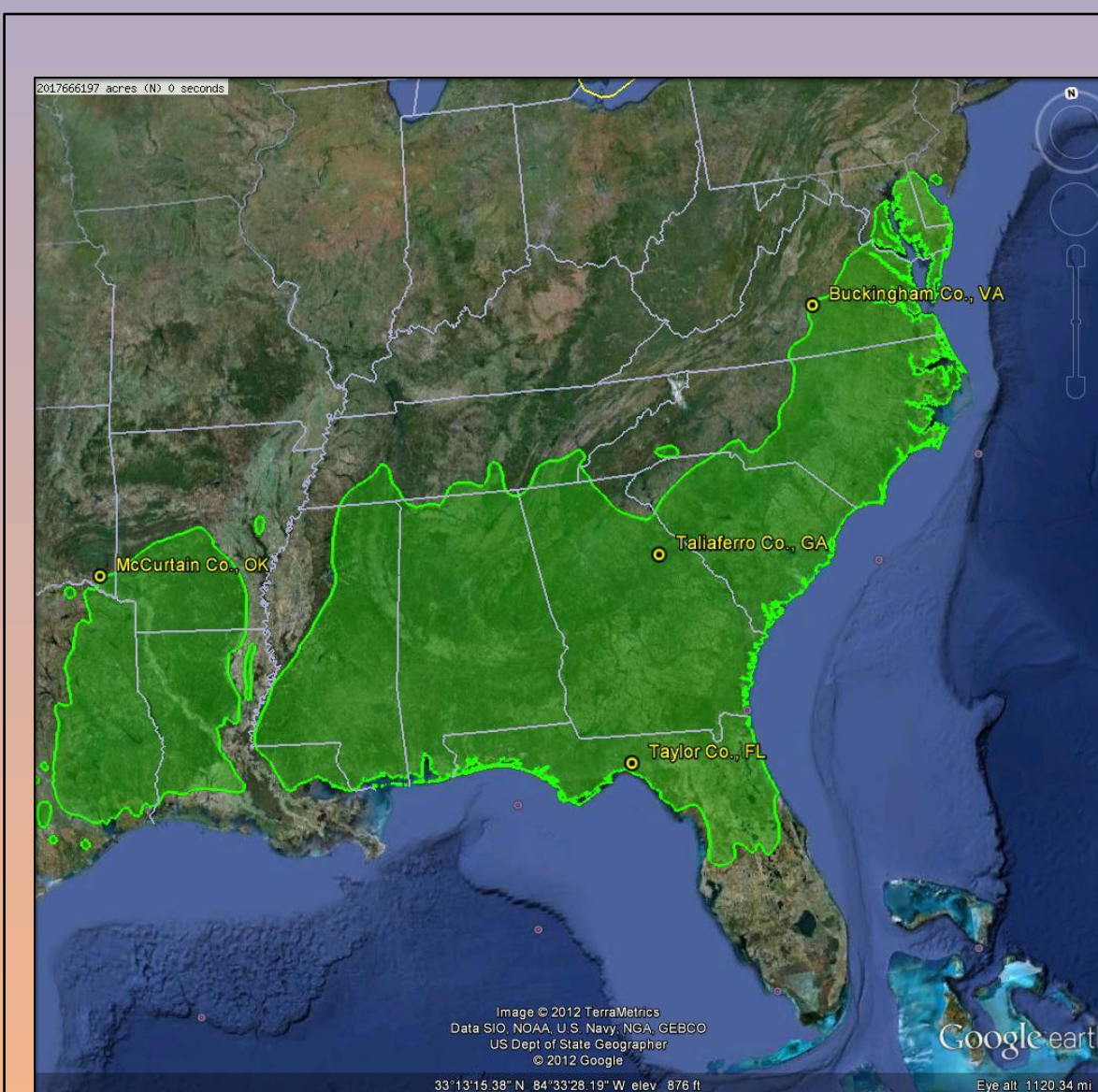


Figure 1. Map showing the location of the four Tier III sites. The green area represents the natural range of loblolly pine.

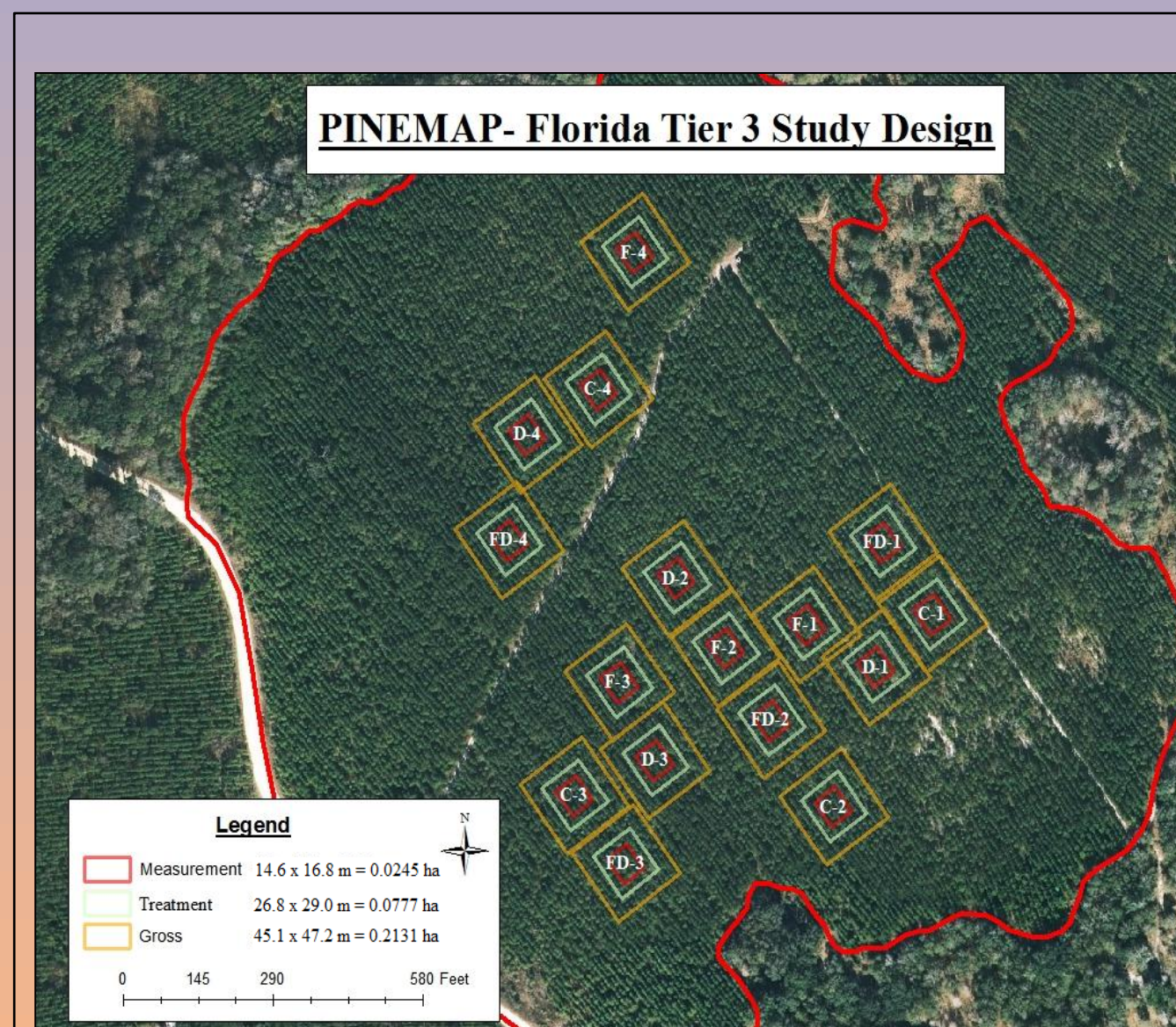


Figure 2. Map showing plot locations at the Florida Tier III site. Treatments are designated as: C – Control, D – 30% rain throughfall exclusion, F – fertilizer addition, FD – Fertilizer plus throughfall exclusion. Numbers designate block/replicate.



Rain throughfall exclusion structures erected below the canopy using pressure treated wood and clear extrusion laminated reinforced film.



Sampling

To ensure data consistency among Tier III sites, standardized sampling protocols were developed. Sampling will occur over a five year period to determine:

- Stand parameters from annual tree measurements (DBH, HT, HTlc, crown width)
- C and N pools and fluxes
- ¹⁵N fertilizer uptake and fate
- NH₃ volatilization and N₂O loss
- Soil chemical and physical properties
- Soil CO₂ efflux (both Rh and Ra)
- Leaf area index (LAI) and intercepted photosynthetically active radiation (IPAR)
- Transpiration rates based on sap flow
- Water use efficiency based on C isotope analysis of wood cores.



LI-COR 6400 infrared gas analyzer used to measure soil CO₂ efflux.



Sap flow sensors used to measure tree water use.

Table 1. Summary of 2011 inventory data from the Florida Tier III installation. Plots are designated as: C – Control, D – 30% rain throughfall exclusion, F – fertilizer addition, FD – Fertilizer plus throughfall exclusion.

REP	PLOT	Average DBH (cm)	Average BA (m ² /ha)	Average HT (m)
1	C	10.2	19.2	9.8
	F	11.2	21.2	10.1
	D	10.2	20.2	10.0
	FD	10.9	21.1	10.5
	Rep avg	10.7	20.4	10.1
	CV%	4.8	4.6	2.9
2	C	11.2	22.4	10.0
	F	10.9	21.0	10.3
	D	10.9	21.9	10.6
	FD	10.4	20.4	10.1
	Rep avg	10.9	21.4	10.2
	CV%	3.1	4.2	2.6
3	C	11.4	22.4	10.1
	F	10.9	22.8	10.5
	D	10.9	20.7	11.2
	FD	11.7	23.2	10.1
	Rep avg	11.2	22.3	10.5
	CV%	3.5	4.9	5.0
4	C	12.4	24.7	10.8
	F	12.4	24.9	11.1
	D	12.4	25.8	11.0
	FD	12.7	27.0	11.6
	Rep avg	12.4	25.6	11.1
	CV%	1.2	4.1	3.1



Please visit <http://www.pinemap.org> for further information