

Effects of Throughfall and Fertilization Manipulation on Water Use of 8-Year-Old Loblolly Pine

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Introduction

The temperatures of the Southeast have increased by 1-2 °C in the last 30 years. A warming atmosphere may increase its water-holding capacity. With that an increase in frequency of intense rainfall events may occur, which can cause surface-water runoff and therefore less soil water availability.

Reduced soil-water availability has been shown to decrease stand productivity. Fertilization on the other hand has been shown to increase stand productivity and in our case of interest, transpiration. Fertilizing in future conditions providing less soil-water may result in greater soil-water depletion.

The objectives of this study is to show the effects of reduced soil-water and fertilization on water use of Loblolly Pine

We predict that increased fertilization will increase leaf area index (LAI) and thus reduce soil-water availability. As a result stomatal conductance (G_s) and transpiration (E_t) will be reduced as well.

Methods and Materials

Our site is a Tier III experimental site located in Taliaferro Co., Georgia. It was planted with second generation, open-pollinated Loblolly pine in 2006.

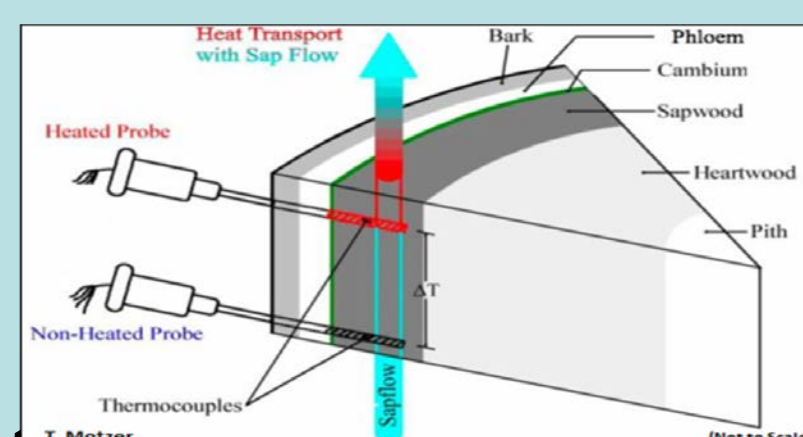


There are four blocks with four different sites in each block. Two sites have reduced throughfall treatments and each have either a certain fertilizer or none. This is replicated in each block.



Troughs were constructed to catch 30% of throughfall. Four different mixtures of fertilizers are used.

Five out of eighty trees were selected in each plot. Sap Velocity was determined using 20 mm thermal dissipation probes



Leaf level water potential was determined using a pressure chamber (PMS Instrument Co., Corvallis, OR).

Two lai 2000 tools were used to calculate LAI. One monitored below canopy light interception while the other monitored above.



-An on site weather station with data logger continually collected data to compare with all previous methods

Results

Differences were seen in LAI with the various fertilizer treatments yet there was no response found that correlated to the throughfall treatments (figure 1)

Fertilization combined with the throughfall reduction was seen to decrease stomatal conductance and the rate of stomatal closure by 37% and 44% respectively. This was not seen where throughfall reduction was not applied. (figure 2)

The throughfall reduction treatments reduced transpiration from 18.6 to 13.4 mm per month when fertilizer was also applied. (figure 3)

Leaf Area Index

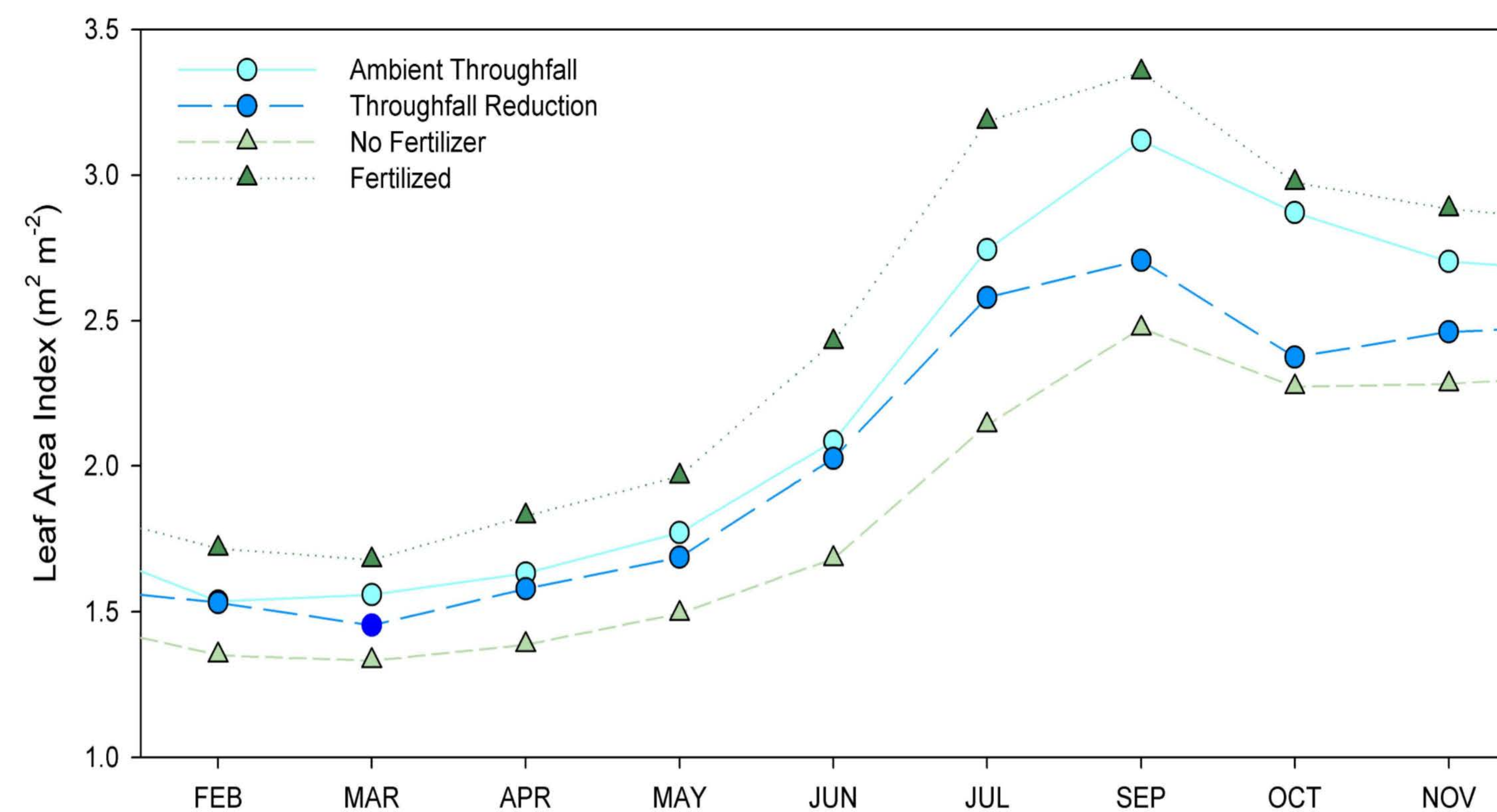


Figure 1: The response of leaf area index (LAI) to throughfall and fertilization treatments from February 2013 to November 2013 (see poster by Pell et al.).

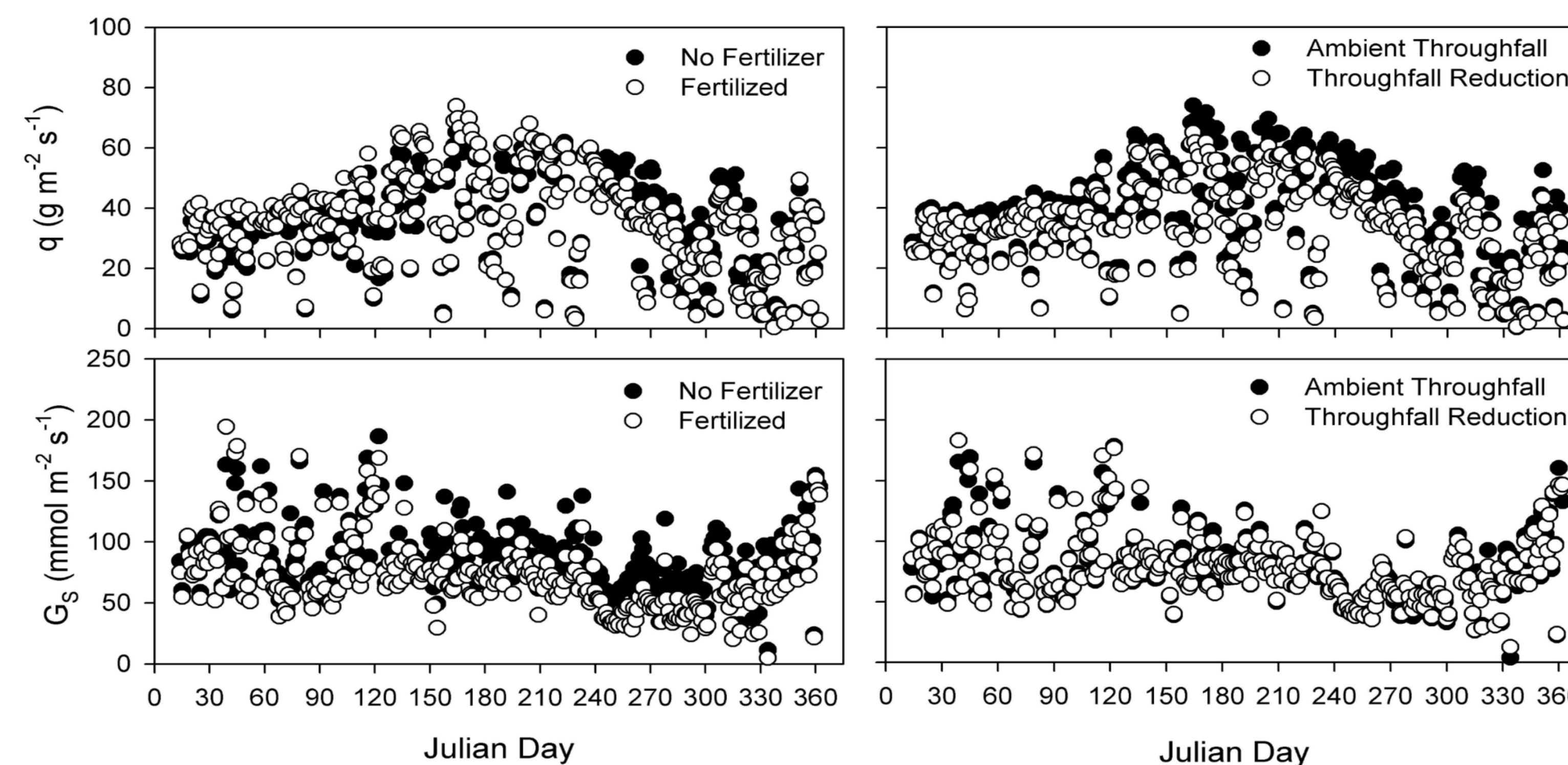


Figure 2. Daytime averaged sap flux density (q) and canopy stomatal conductance (G_s) in response to throughfall reduction and fertilization treatments from January 2013 to December 2013 in 8-year-old loblolly pine.

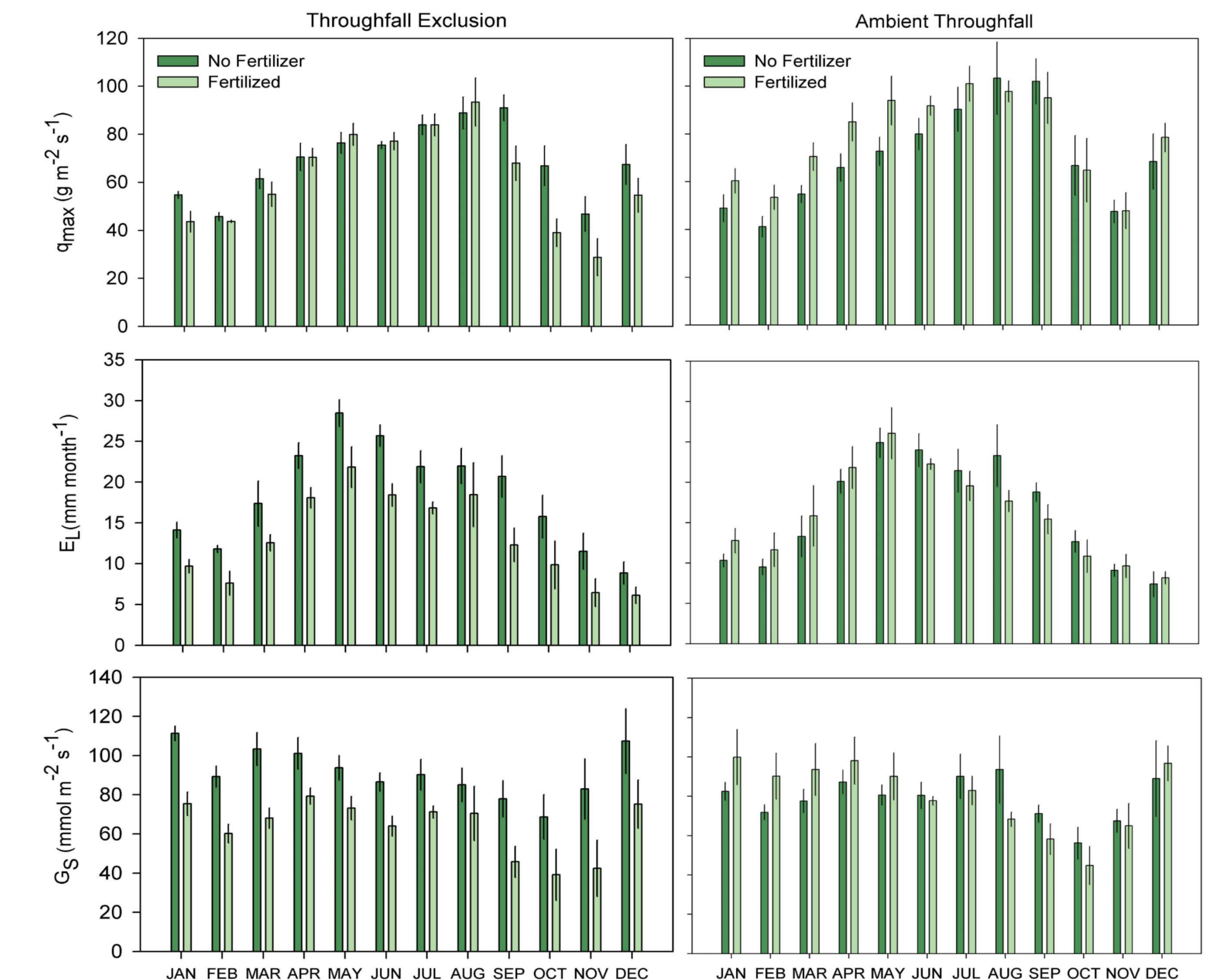


Figure 3: Average midday maximum sap flux density (q_{MAX}), Canopy stomatal conductance (G_s), and monthly transpiration per unit leaf area (E_t) of 8-year-old loblolly pine in response to fertilization treatment within the throughfall reduction and ambient throughfall treatments from January 2013 to December 2013.

Conclusion

Throughfall exclusion alone showed no significant effects but when combined with fertilizer results were seen. Fertilizer reduced transpiration, stomatal conductance and stomatal closure which limited ground transpiration but increased LAI.

This along with no correlation between growth and throughfall reduction in 2013, show that the trees react and act more conservative with water use when necessary. 2012 had unusually high precipitation while 2013 showed higher than normal rates. Due to this more data is needed before quantifiable evidence can show a strong trend between reduced soil-water availability and stand level physiology.

Acknowledgements

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