Practical Considerations for Minimizing Environmental Impact of Turf Nutrition

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Overview

- Nutrient import from newly laid sod.
- Plant nutrition needs based on *Turfgrass Growth Potential* models.
- Nutrient leaching from slow release materials releasing while turf is semi-dormant or dormant.
- Nutrient leaching from turf that experienced injury from disease, winter kill, or decline attributed to over-management.

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Nutrient Import from Sod

- Properly harvested sod comes with ~ ½” of soil.
  - Nutrients applied at the farm are likely transported with the sod.
- Irrigation during sod establishment can be excessive if guidelines are not followed properly.

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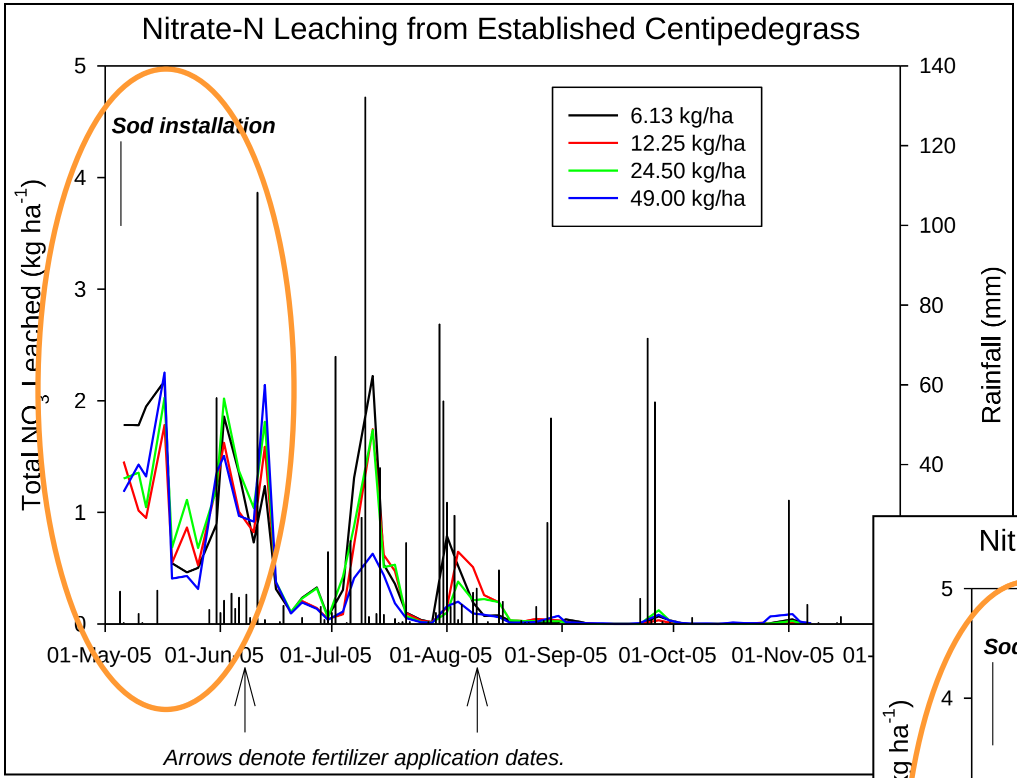
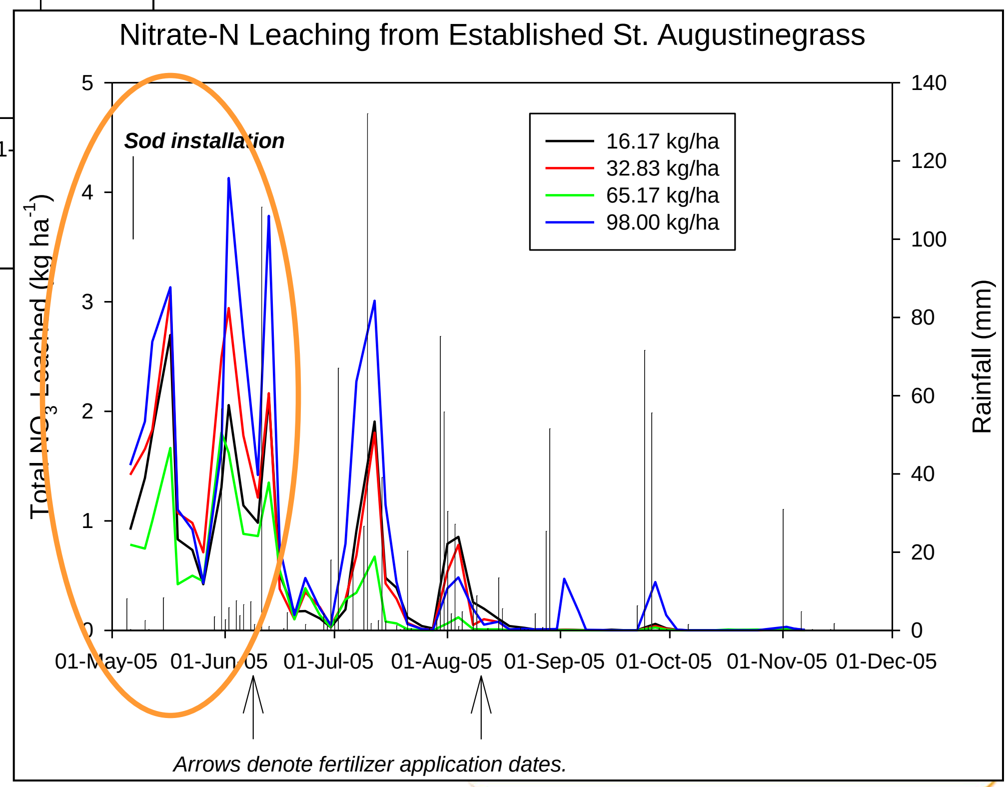
Nutrient Import from Sod





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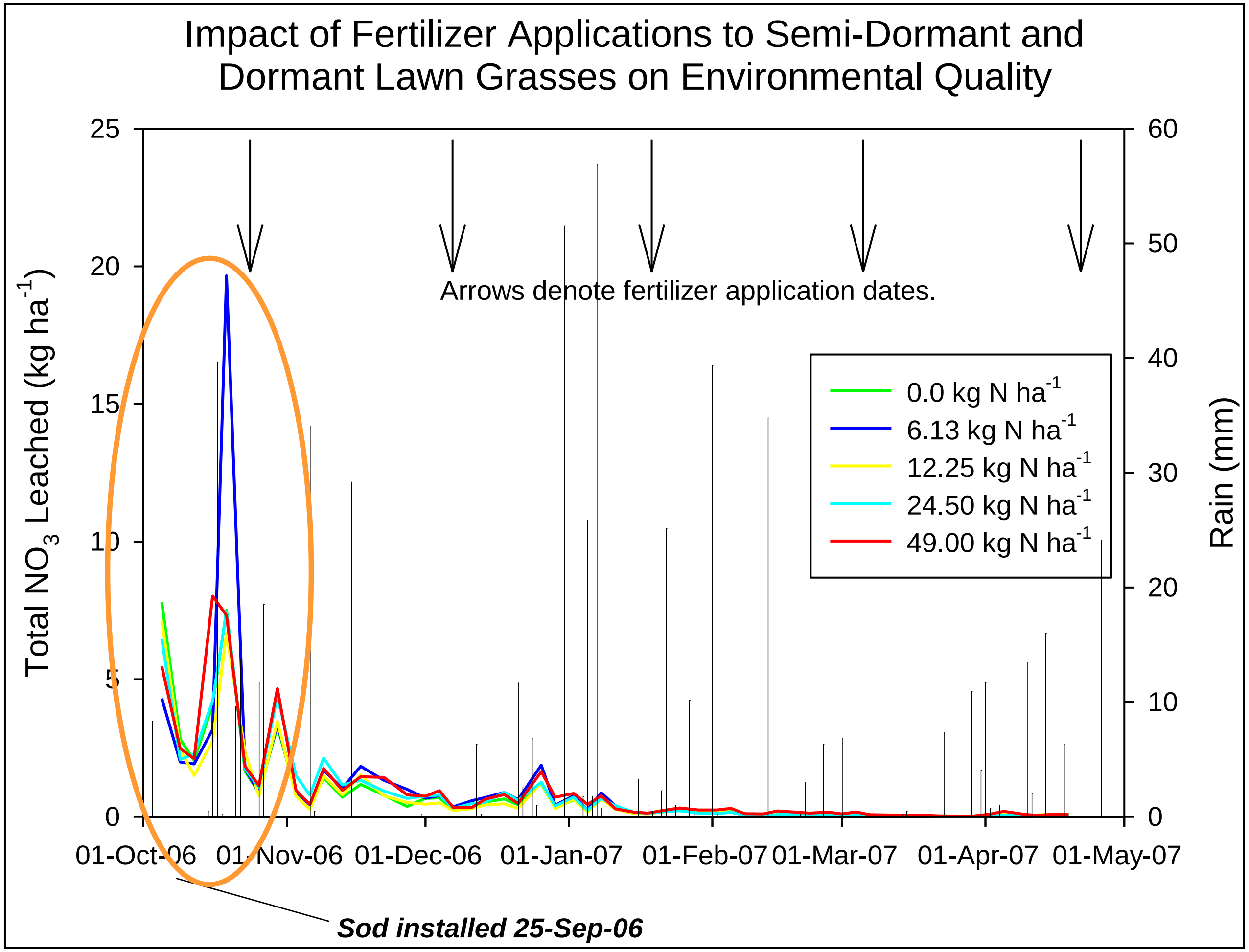
Nutrient Import from Sod



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Nutrient Export

- In some regions of the US, waste products are being used on sod production fields with the intent of exporting nutrients into the urban environment where they will be used by the turf.

Waste Streams from Methane Digesters: Exporting Nutrients through Turfgrass and Forage Production Systems

Ronnie W. Schnell,* Donald M. Vietor, Tony L. Provin, and Clyde L. Munster

Agronomy, Soils & Environmental Quality

ABSTRACT

Similar to manure, residual manure solids (MS) from methane digesters require cropping systems and management practices that optimize nutrient export to prevent large increases in soil P levels. The objectives were to compare forage and turfgrass sod production systems with respect to effects of MS management practices on soil properties and crop productivity and to compare mass balance of N and P on field scale. A 2-yr field experiment was conducted on a fine sandy loam soil receiving MS to compare nutrient imports, forms in soil, and export by Tifton 85 bermudagrass (*Cynodon* spp.) grown for forage and Tifway bermudagrass [*C. dactylon* (L.) Pers. × *C. transvaalensis* (Burtt-Davy)] grown for turfgrass sod. Five soil treatments for each crop included MS with and without Alum topdressed (250 kg total phosphorus [TP] ha^{-1}) annually or a single application of MS (500 kg TP ha^{-1}) incorporated compared to soil without MS. One harvest of Tifway sod removed 2.7 times more total nitrogen (TN) and 2.8 times more TP than three harvests of Tifton 85 forage biomass during the first year of production. Greater biomass production and nutrient uptake by Tifton 85 forage during the second production season reduced the difference in nutrient export between Tifton 85 and Tifway sod. Turfgrass sod production systems can be used by producers to increase export of MS applied nutrients compared to forage production and enable waste streams from methane digesters to be recycled.

INTENSIFICATION OF ANIMAL feeding operations contributes to increases in livestock numbers, nutrient loading on surrounding cropland and concerns about off-farm environmental impact (Sharpley et al., 2004). Diverting livestock waste from cropland into bioenergy facilities for methane production offers an opportunity to reduce the amount and frequency of manure applied to available cropland. However, recycling MS generated from methane digesters could pose environmental risks to surrounding cropland, similar to manure. Like manure applications, limited hauling distances necessitates cropping systems to maximize export of nutrients contained in MS.

Uptake of manure and wastewater derived N and P in forage harvests has been evaluated for year-round cropping systems. Adapted forage crops were grown and harvested to remove N and P and prevent nonpoint-source losses of N and P. Woodard et al. (2007) reported annual harvests from a bermudagrass/rye cropping system removed 67 kg P ha^{-1} $cycle^{-1}$. Ketterings et al. (2007) reported a two-cut system applied to brown midrib sorghum in New York removed up to 510 kg N ha^{-1} yr^{-1} and 101 kg P ha^{-1} yr^{-1}. Brink et al. (2004) observed average uptake and export of 300 kg N ha^{-1} yr^{-1} and 46.5 kg P ha^{-1} yr^{-1} in forage harvested from Tifton 85 bermudagrass in Mississippi. However, availability and fate of nutrients in soil applied MS are uncertain and could affect biomass production, nutrient uptake, and nutrient export by forages receiving MS.

Studies of manure cycling to turfgrass revealed an option for exporting two to three times more P through sod than through annual forage harvests (Vietor et al., 2002). A single harvest of Tifway bermudagrass sod exported up to 561 kg ha^{-1} of total N and 219 kg ha^{-1} of total P applied as raw or composted dairy manure (Vietor et al., 2002). Sod harvests typically removes about a 2-cm depth of soil in addition to turfgrass biomass. Calculations of nutrient export for sod includes the mass of nutrients found in soil and plant fractions of the harvested sod layer. To determine manure sources of nutrient exported by sod, nutrients found in sod grown without manure were subtracted from the amount removed by sod grown with manure (Vietor et al., 2002). The thin layer of soil removed by sod harvest is expected to effectively remove and export MS sources of organic and inorganic nutrients. While soil and turfgrass responses to nutrients and C found in compost and manures have been investigated, soil and turf responses to MS are unknown.

Forage or turfgrass sod production for disposal and utilization of MS generated by bioenergy facilities would likely involve large or repeat applications of MS. Large application rates of MS necessitate production practices that optimize crop production and minimize environmental impacts. For example, amending manure with aluminum sulfate (alum) before surface application can significantly reduce concentrations of water-extractable P in soil and decrease runoff concentrations of dissolved reactive P (DeLaune et al., 2006). Mixing alum with MS before surface

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Abbreviations: Alum, aluminum sulfate; DK, dissolved potassium; DRP, dissolved reactive phosphorus; MS, manure solids; M3K, Mehlich-3 potassium; M3P, Mehlich-3 phosphorus; TDP, total dissolved phosphorus; TK, total potassium; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus.

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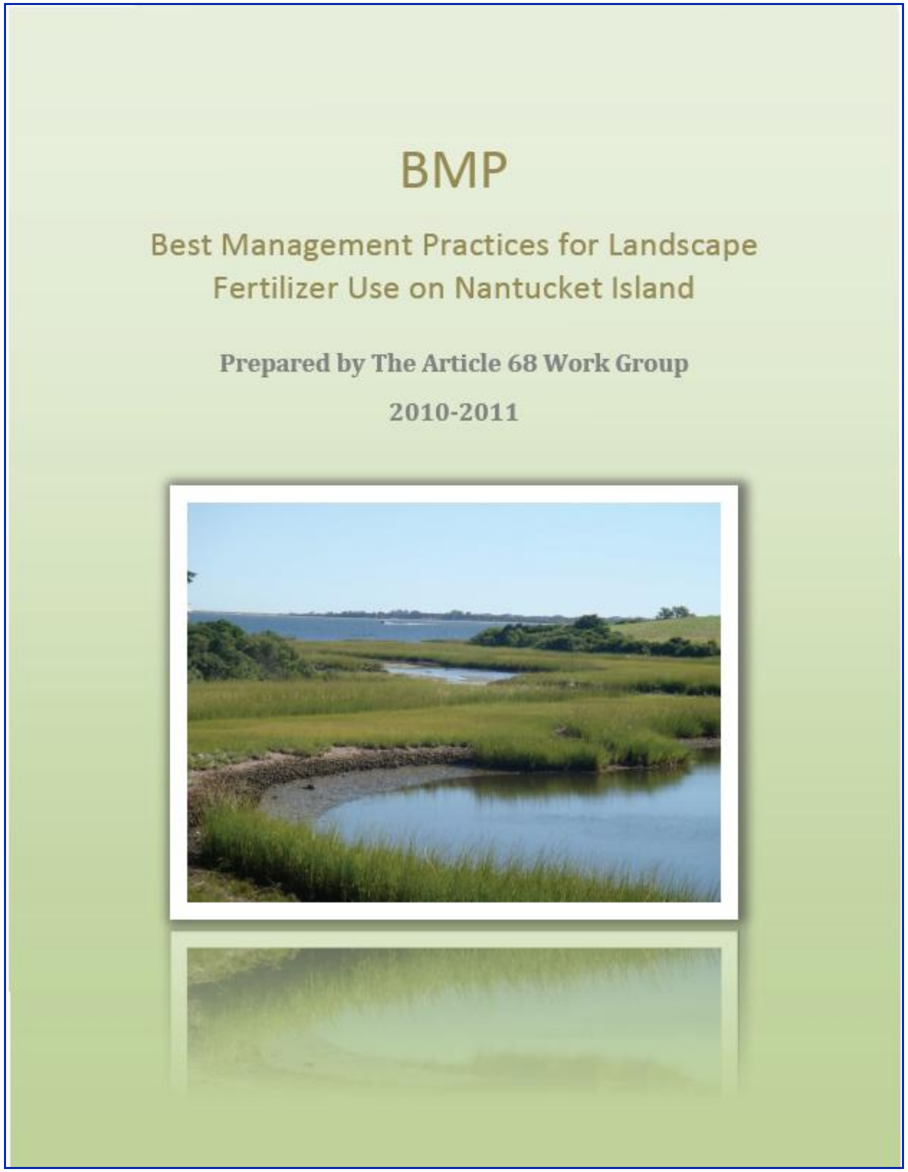
Practical Considerations

- Avoid fertilization of newly laid sod for 30 – 60 days.
  - Sufficient nutrients likely exist.
- Encourage sod installers/landscapers to inquire about the timing of the last farm-applied nutrients.
  - Use ranges rather than specific dates
    - < 2 weeks = no fertilizer for 60 days
    - 2 – 4 weeks = no fertilizer for 30 – 60 days
    - > 4 weeks = no fertilizer for 30 days
  - This could prove burdensome for less "tech-savvy" producers.

Nantucket Island, MA



BMP

Best Management Practices for Landscape Fertilizer Use on Nantucket Island

Prepared by The Article 68 Work Group

2010-2011

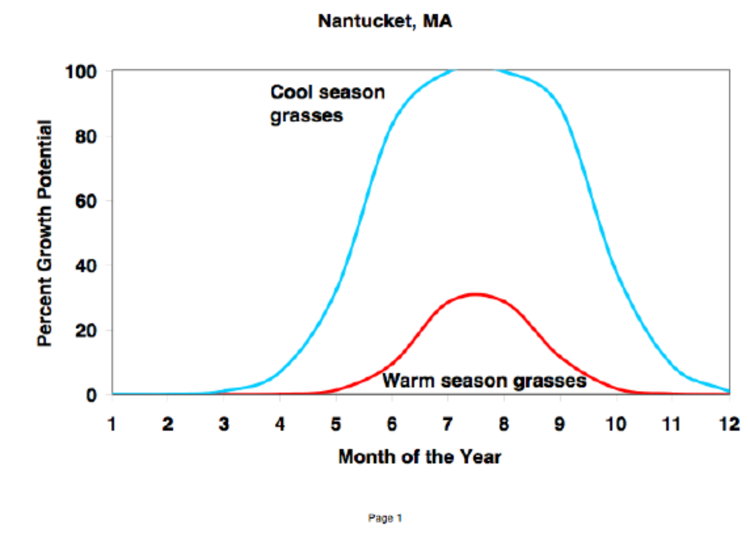


Figure 2. A Growth-Potential Graph Applying Climate-Appraisal Data to Nantucket Turf.

$$GP = 100\left[\frac{1}{e^{\left[\frac{1}{2}\left[\frac{obsT - optT}{sd}\right]^2\right]}}\right]$$

GP = growth potential
obsT = observed temperature (F)
optT = optimum turf growth temperature (F)
sd = standard deviation of the distribution
(sd warm = 12; sd cool = 10)
e = natural logarithm base **2.718282…**

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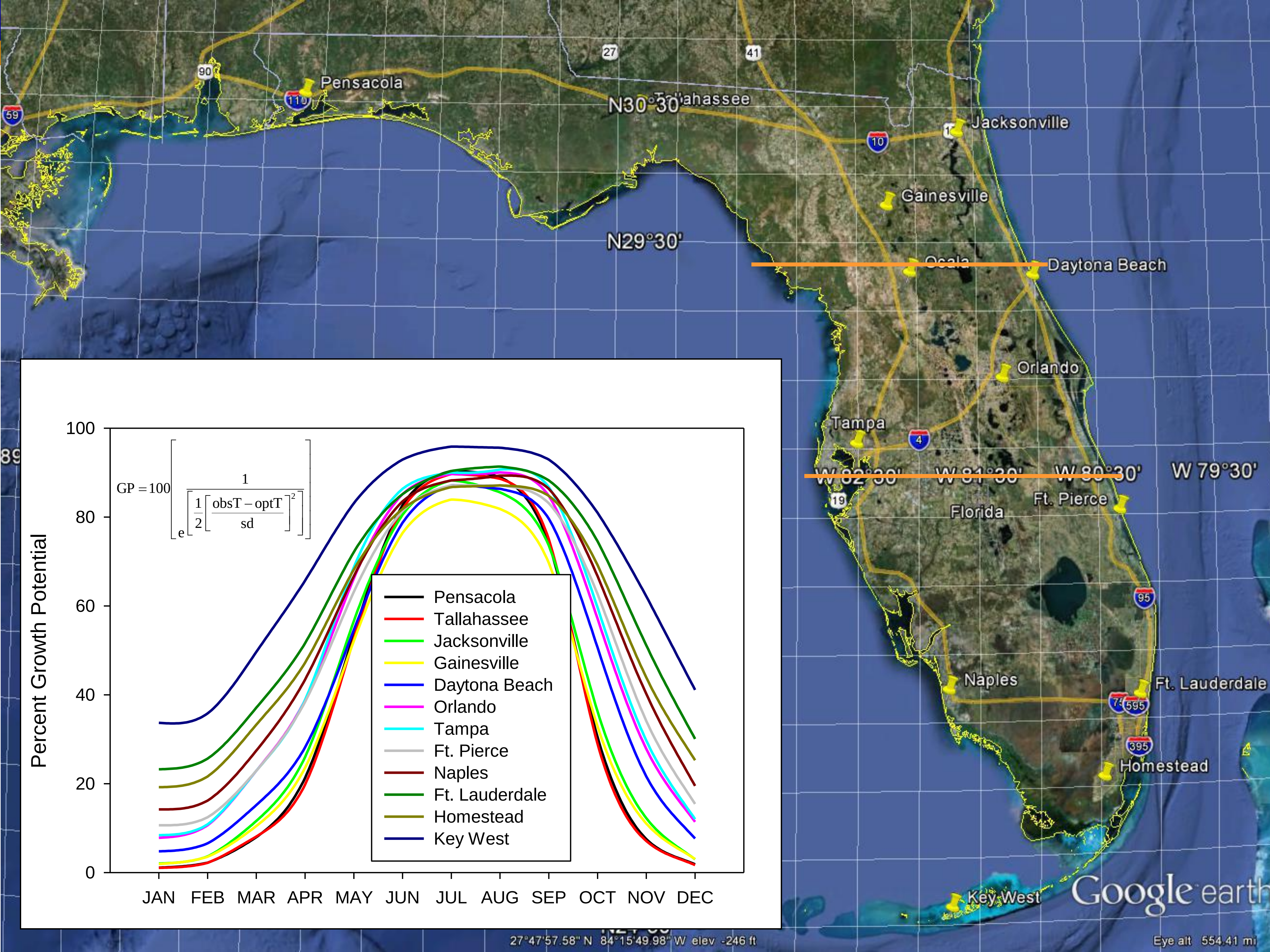
PACE TURF
http://www.paceturf.org/



Pensacola
Tallahassee
N30°30'
Jacksonville
Gainesville
N29°30'
Ocala
Daytona Beach
Orlando
Tampa
W 82°30'
W 81°30'
W 80°30'
W 79°30'
Ft. Pierce
Florida
Naples
Ft. Lauderdale
Homestead
Key West
Google earth
27°47'57.58" N 84°15'49.98" W elev -246 ft
Eye alt 554.41 mi
GP = 100 [1 / e^([1/2 [(obsT – optT)/sd]]^2)]
Percent Growth Potential
0
20
40
60
80
100
JAN
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APR
MAY
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AUG
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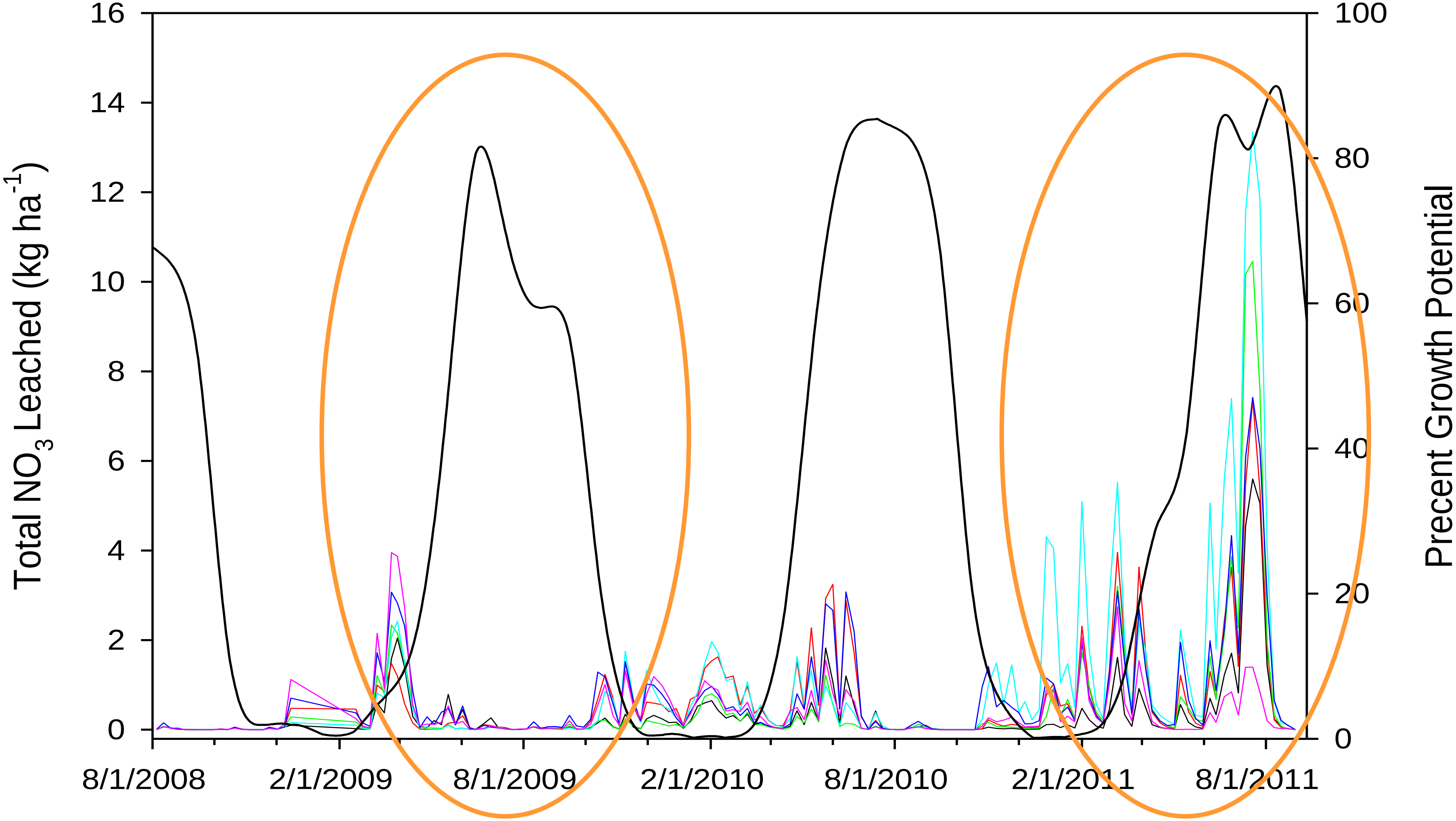
SR Nitrogen Source Study – Jay, FL



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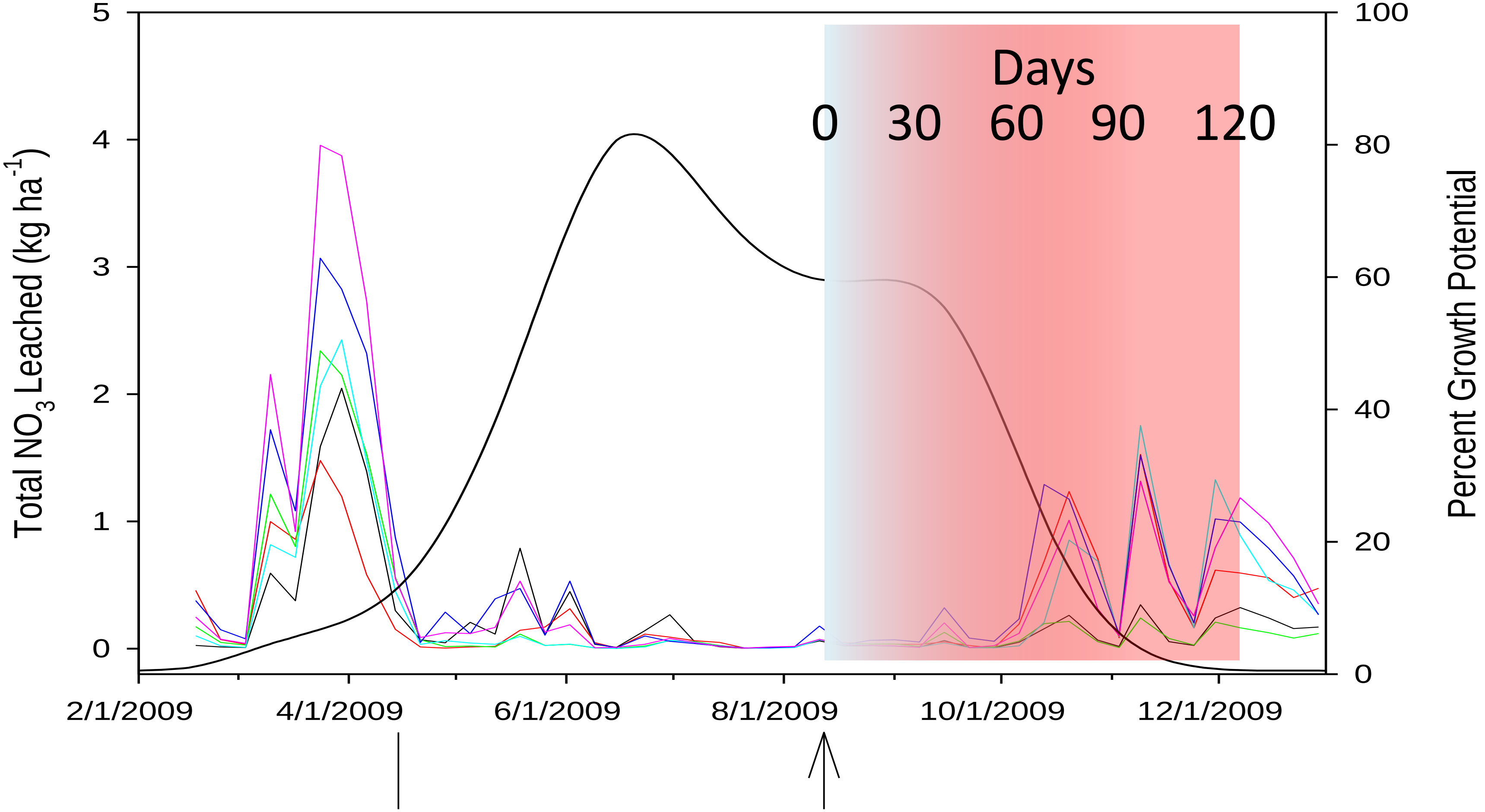

Arrows denote fertilizer application dates.

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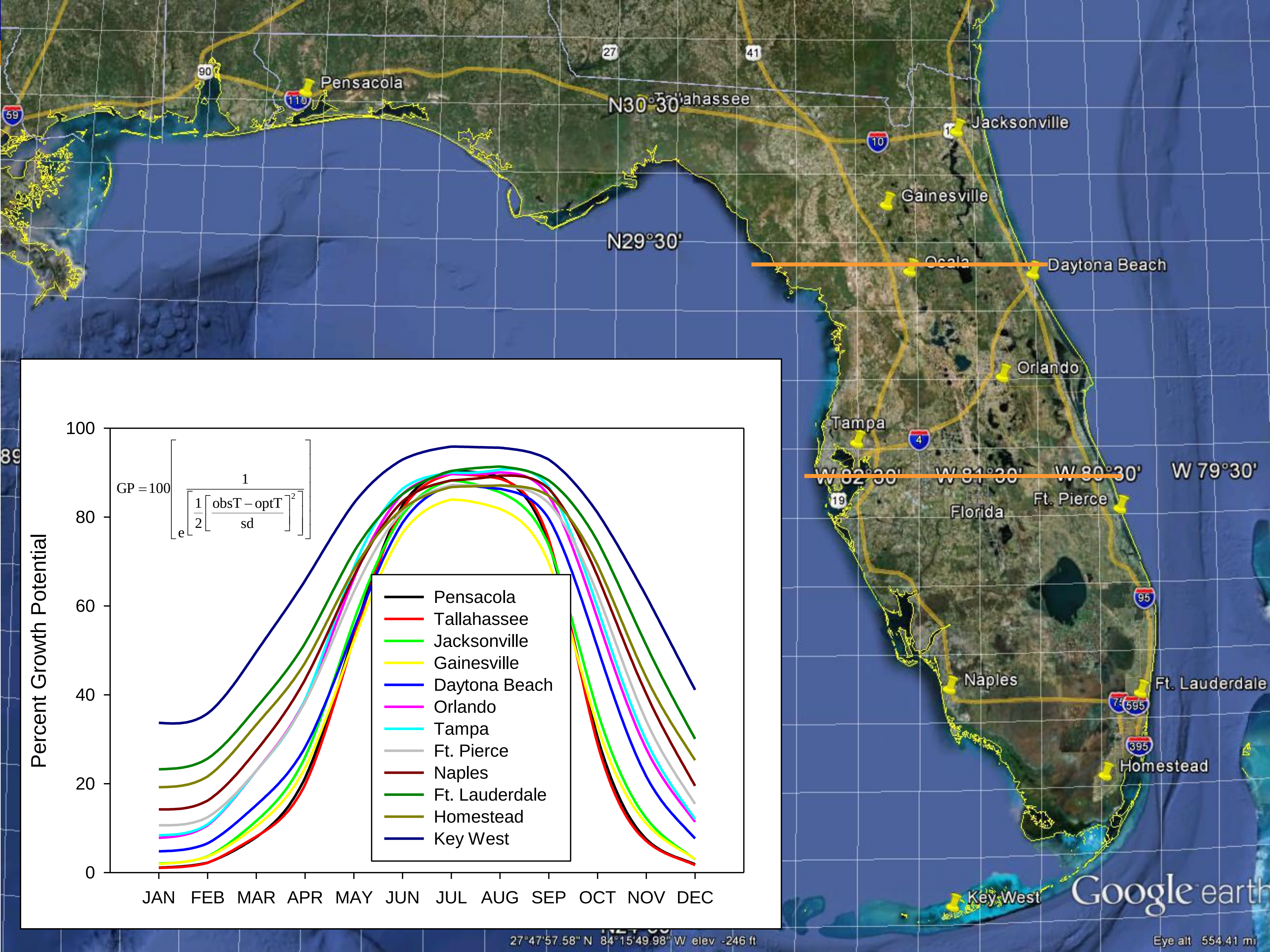

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Percent Growth Potential
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JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
$GP = 100\left[\frac{1}{e^{\left[\frac{1}{2}\left[\frac{obsT - optT}{sd}\right]^2\right]}}\right]$
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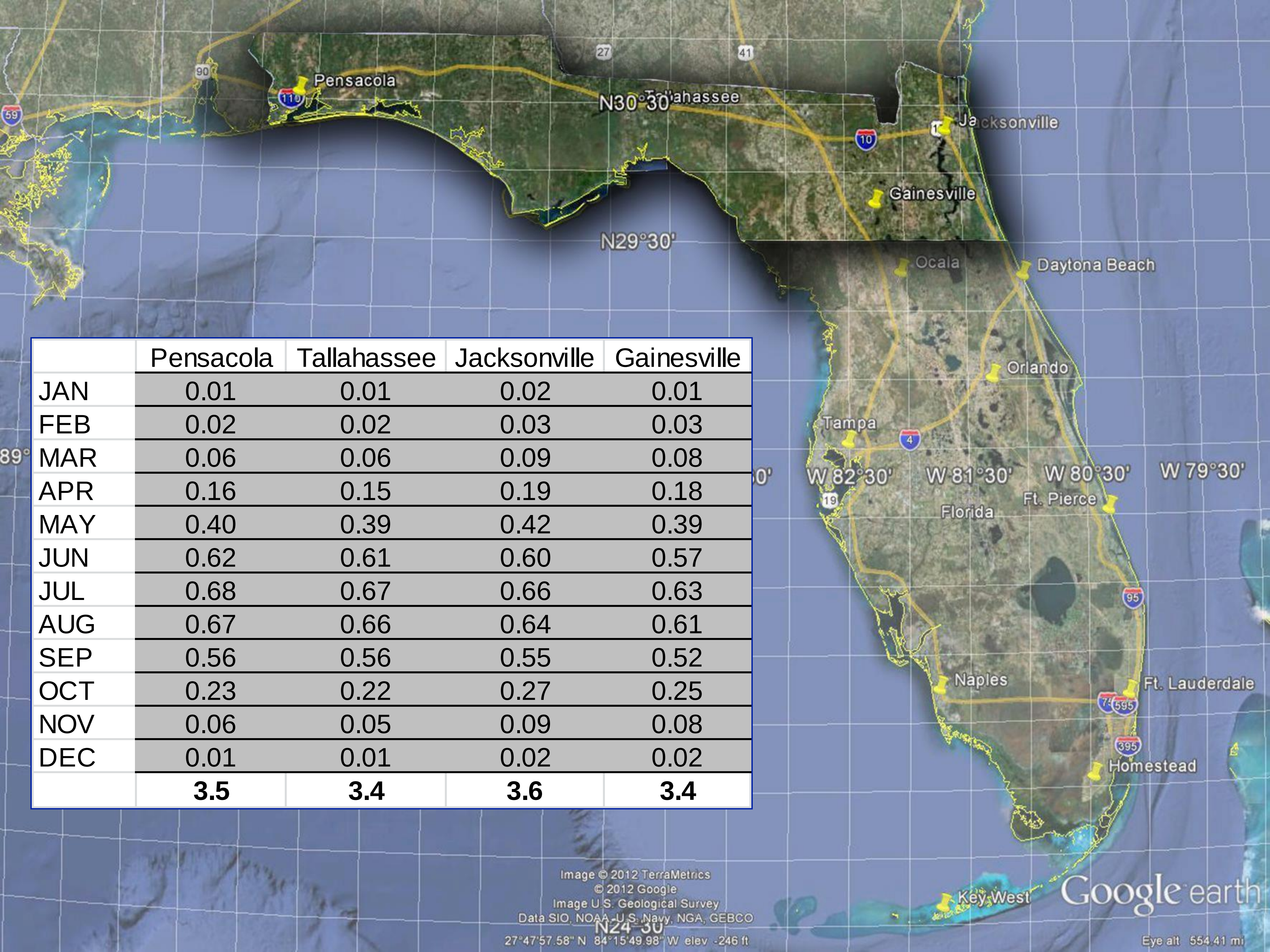
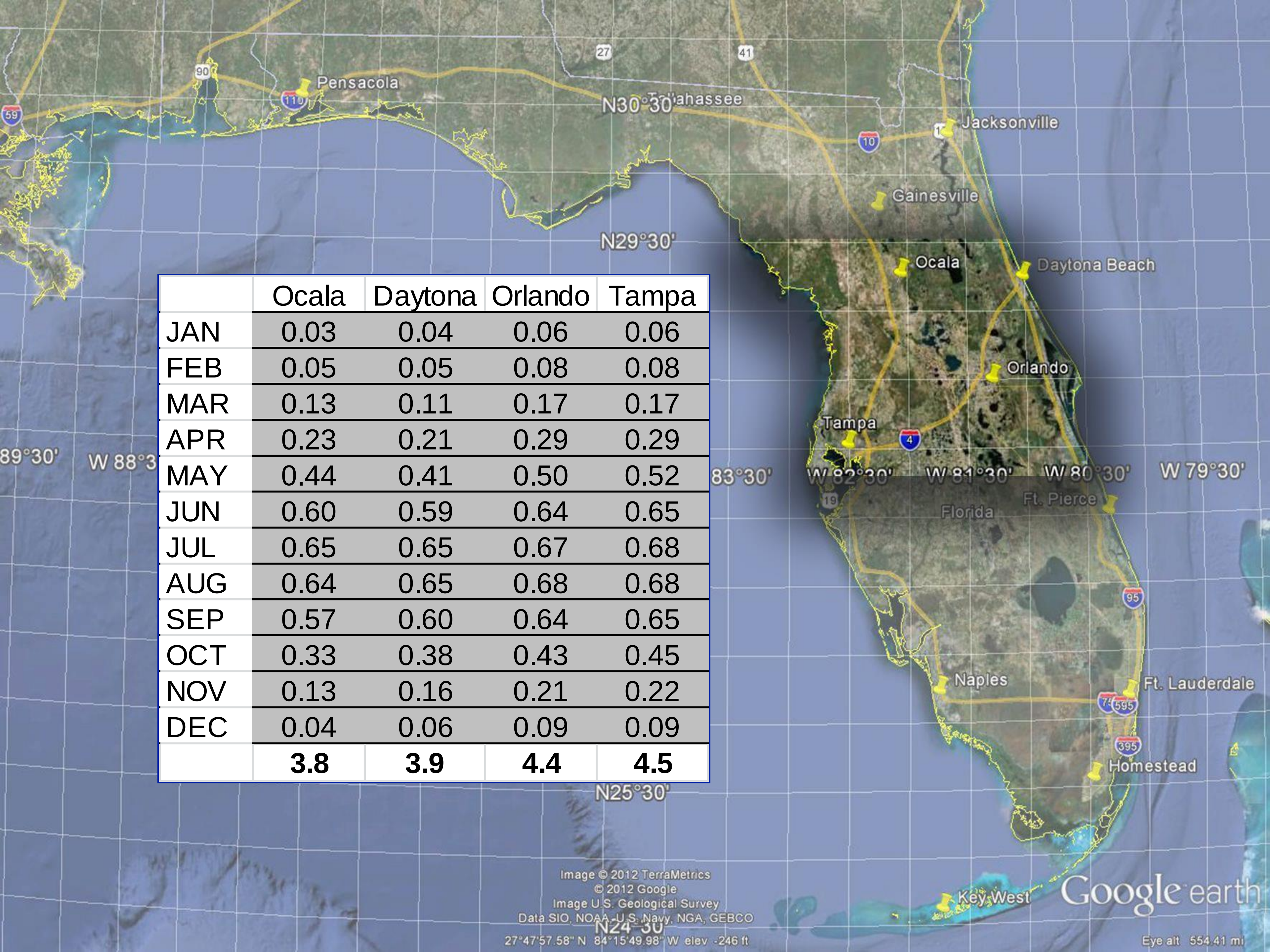
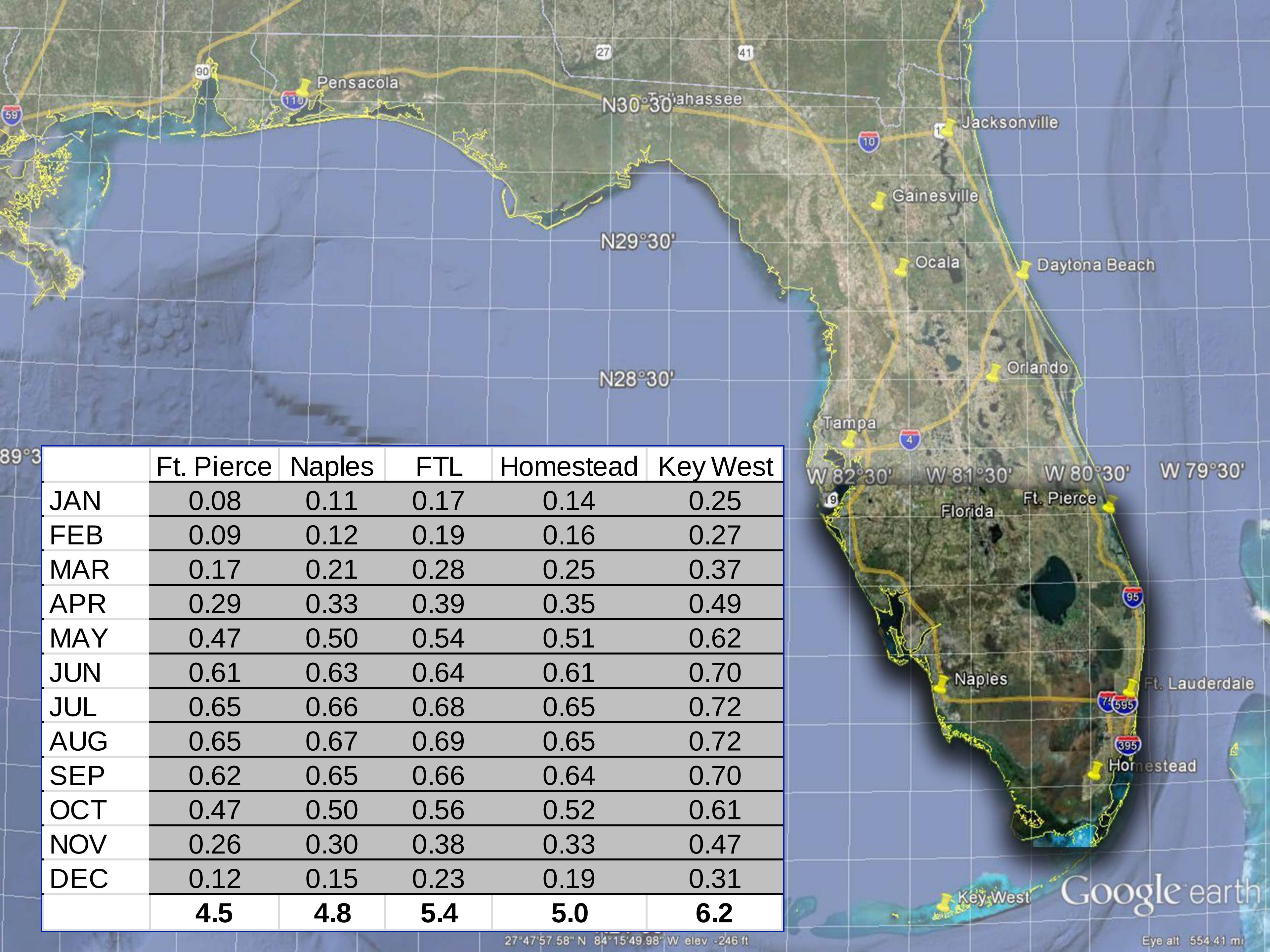


	Pensacola	Tallahassee	Jacksonville	Gainesville
JAN	0.01	0.01	0.02	0.01
FEB	0.02	0.02	0.03	0.03
MAR	0.06	0.06	0.09	0.08
APR	0.16	0.15	0.19	0.18
MAY	0.40	0.39	0.42	0.39
JUN	0.62	0.61	0.60	0.57
JUL	0.68	0.67	0.66	0.63
AUG	0.67	0.66	0.64	0.61
SEP	0.56	0.56	0.55	0.52
OCT	0.23	0.22	0.27	0.25
NOV	0.06	0.05	0.09	0.08
DEC	0.01	0.01	0.02	0.02
	3.5	**3.4**	**3.6**	**3.4**

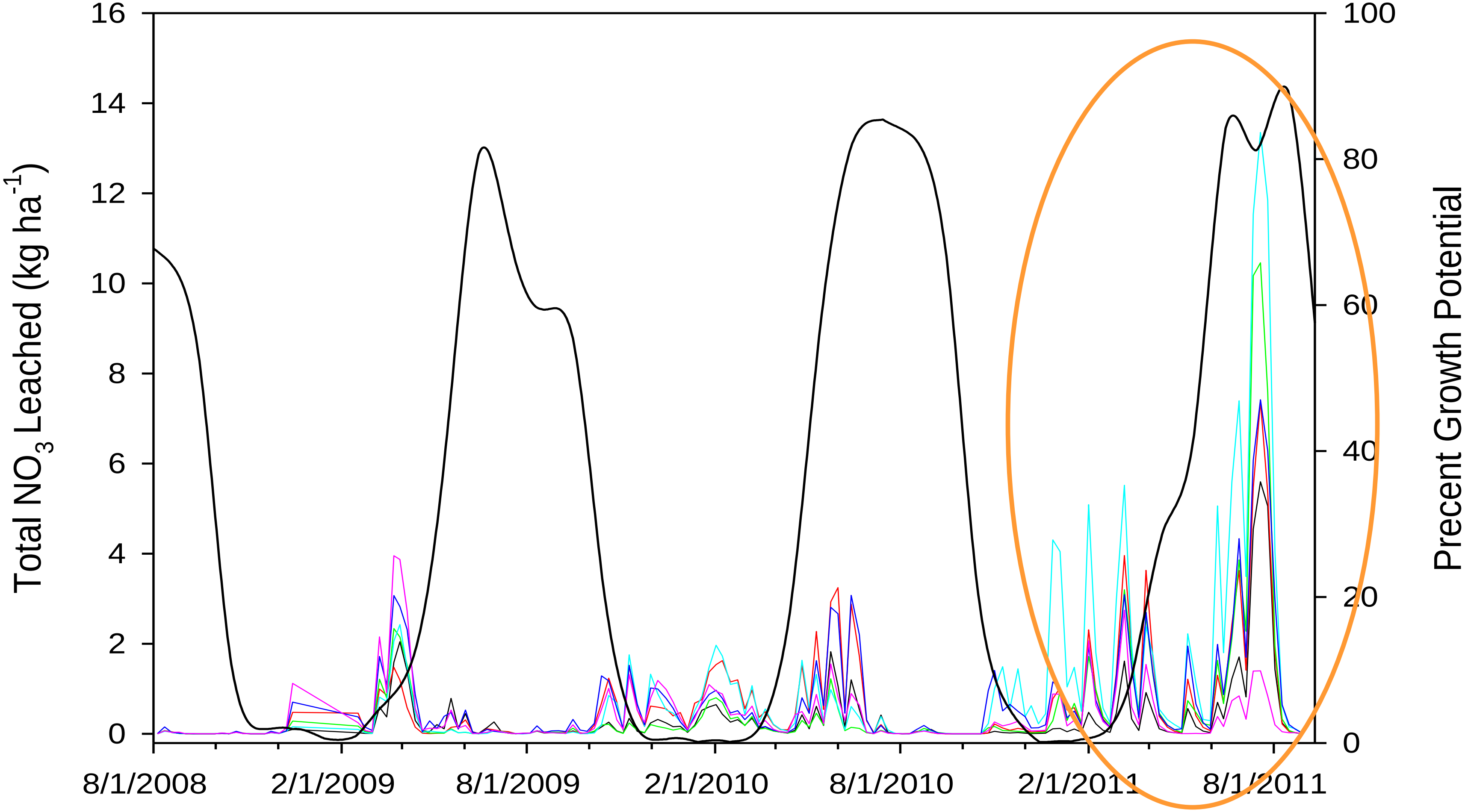


	Ocala	Daytona	Orlando	Tampa
JAN	0.03	0.04	0.06	0.06
FEB	0.05	0.05	0.08	0.08
MAR	0.13	0.11	0.17	0.17
APR	0.23	0.21	0.29	0.29
MAY	0.44	0.41	0.50	0.52
JUN	0.60	0.59	0.64	0.65
JUL	0.65	0.65	0.67	0.68
AUG	0.64	0.65	0.68	0.68
SEP	0.57	0.60	0.64	0.65
OCT	0.33	0.38	0.43	0.45
NOV	0.13	0.16	0.21	0.22
DEC	0.04	0.06	0.09	0.09
	3.8	**3.9**	**4.4**	**4.5**



	Ft. Pierce	Naples	FTL	Homestead	Key West
JAN	0.08	0.11	0.17	0.14	0.25
FEB	0.09	0.12	0.19	0.16	0.27
MAR	0.17	0.21	0.28	0.25	0.37
APR	0.29	0.33	0.39	0.35	0.49
MAY	0.47	0.50	0.54	0.51	0.62
JUN	0.61	0.63	0.64	0.61	0.70
JUL	0.65	0.66	0.68	0.65	0.72
AUG	0.65	0.67	0.69	0.65	0.72
SEP	0.62	0.65	0.66	0.64	0.70
OCT	0.47	0.50	0.56	0.52	0.61
NOV	0.26	0.30	0.38	0.33	0.47
DEC	0.12	0.15	0.23	0.19	0.31
	4.5	**4.8**	**5.4**	**5.0**	**6.2**

SR Nitrogen Source Study – Jay, FL



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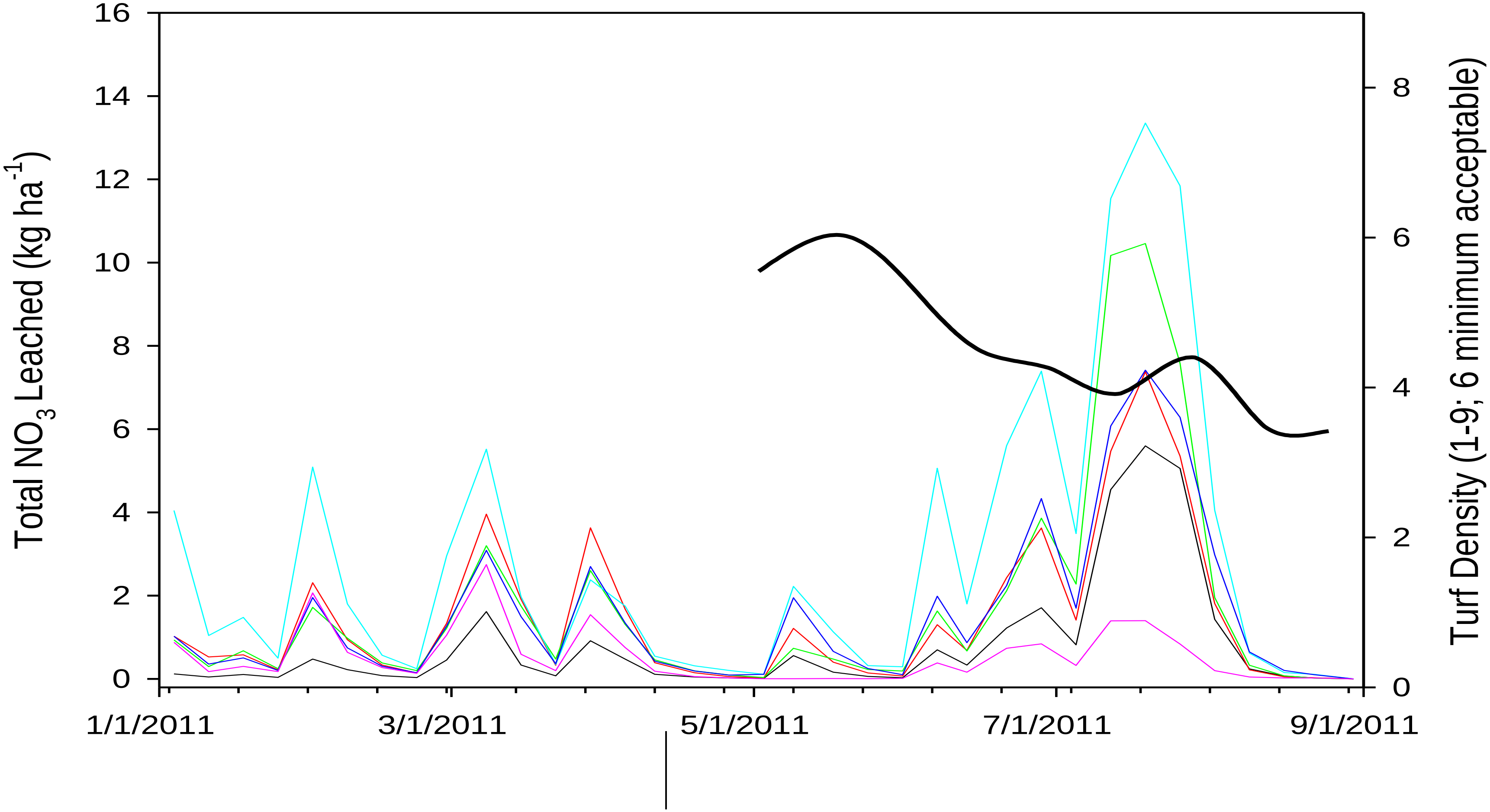

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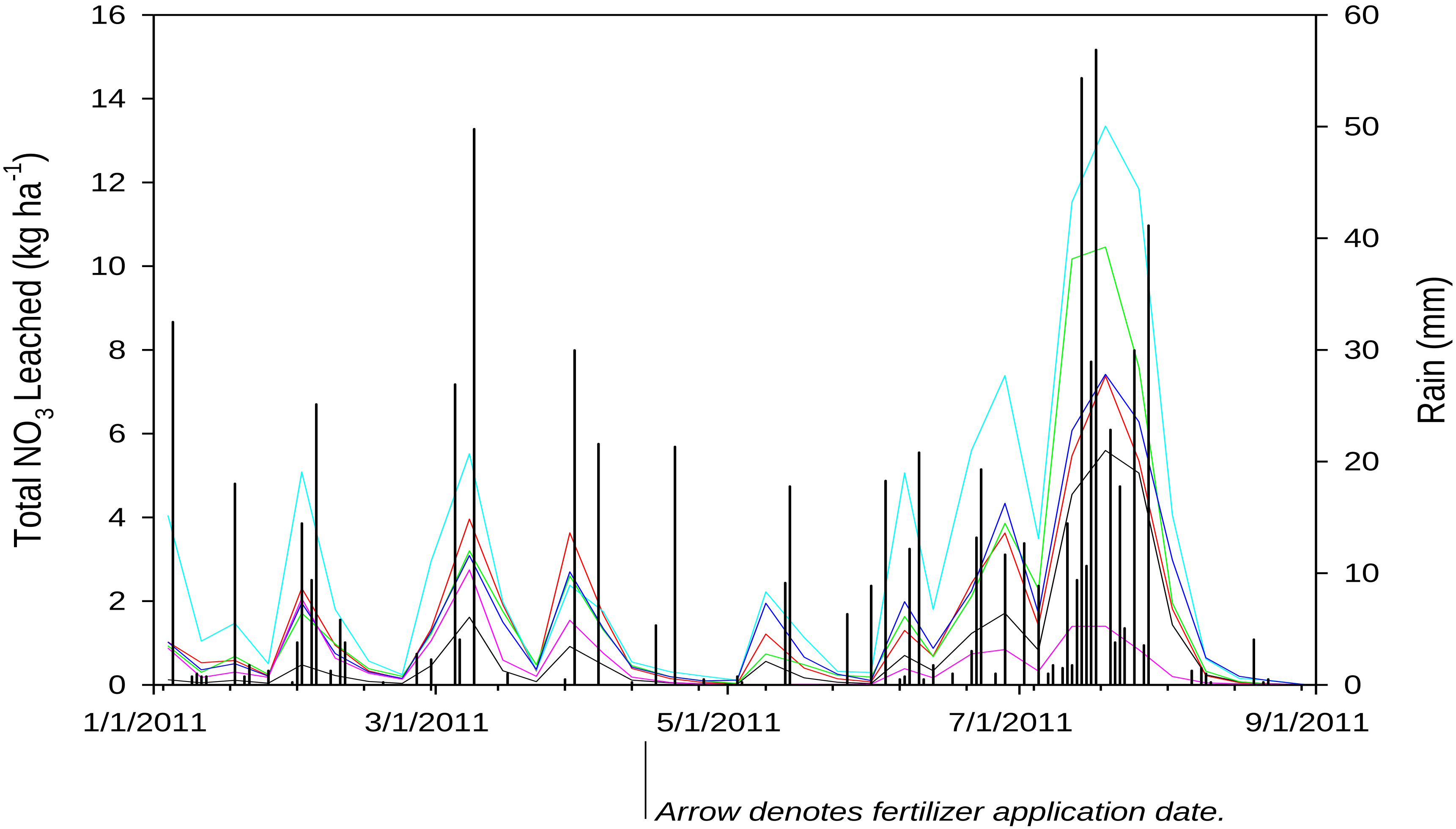

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Practical Considerations

- Nutrients must be applied based on the plant's ability to assimilate them.
  - This should supersede any calendar-based regimen.
- Healthy, dense turf is the key to minimizing environmental impact of applied nutrients.
  - As the health of the plant deteriorates – one can expect problems.

Practical Considerations

- Timing of application of enhanced efficiency (SR) nutrient sources should coincide with periods of active growth potential.
  – The "release period" should not extend beyond periods of active growth.

Review

- Nutrient import from newly laid sod.
- Plant nutrition needs based on *Turfgrass Growth Potential* models.
- Nutrient leaching from slow release materials releasing while turf is semi-dormant or dormant.
- Nutrient leaching from turf that experienced injury from disease, winter kill, or decline attributed to over-management.

Turfgrass Nutrient Management Symposium

Results from the FDEP-Funded

"Evaluation of Urban Warm-Season Turfgrass Fertilization and Irrigation Best Management Practices to Minimize Nutrient Leaching Project"

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