# In-field Weathering influences Harvestable Biomass Yield and Biofuel Quality of Warm-Season Grasses in the Lincoln Hills, of Elsberry, Missouri

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USDA NRCS United States Department of Agriculture Natural Resources Conservation Service

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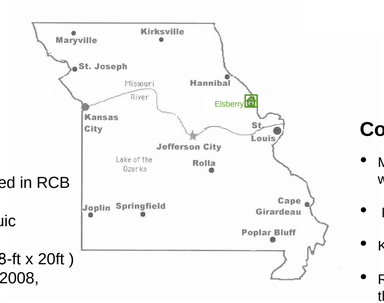
## Abstract

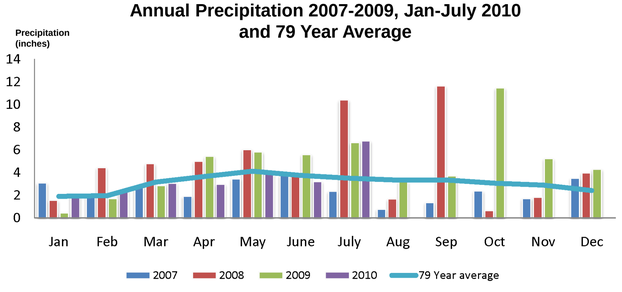
Energy derived from direct combustion of biomass requires feedstocks low in nutrients, ash and moisture concentrations. In-field weathering offers a practical management strategy for improving biofuel quality of the feedstock, however prolong weathering may decrease harvestable biomass. Objective of our study is to evaluate switchgrass (*Panicum virgatum*), big bluestem (*Andropogon gerardii*) indiangrass (*Sorghastrum nutans*) and giant miscanthus ( *Miscanthus x giganteus)* biomass yield and biofuel quality influenced by in-field weathering in the Lincoln County Hills of Elsberry Missouri. Replicated plots of 'Alamo', 'Kanlow'; Cave-in-Rock' Switchgrass, 9083274 Big Bluestem; 'Rumsey' Indiangrass and 'Freedom' Miscanthus were harvested for biomass at seed maturity, then every 6 weeks for approximately 24 weeks (5 total harvests) during 2008-2010. Samples collected from each harvest were used to determine nutrient analyses (N, K, Ca, S), total ash, and moisture concentrations. Weathering did significantly reduce biomass in lb/acre of Alamo (21%), Kanlow (20%), Cave-in-rock (31%) , 9083274 big bluestem (32%) , Rumsey indiangrass (15%); however Miscanthus increase +(13%) during 2008-2009 compared to the initial harvest. Conversely, biomass was again reduced by infield weathering in 2009-2010 harvests except for Miscanthus and Kanlow switchgrass. The greatest biomass loss occurred in the 9083274 Big Bluestem with (18%). The highest Biomass yields were harvest dates in November-December in general for all six varieties. Nutrients, total ash, and moisture concentrations decreased in all grasses after initial harvest. Preliminary results indicate in-field weathering reduces nutrients, total ash, and moisture concentrations in switchgrass, big bluestem , Indiangrass and Miscanthus grown for biomass in the Lincoln Hills of Missouri, and biomass loss is influenced by the amount and type of precipitation received during the weathering period.

## Materials and Methods

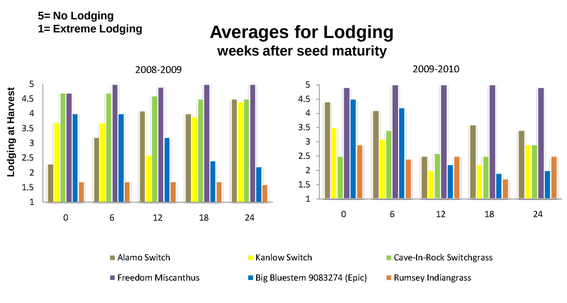
- **Location**: USDA-NRCS Elsberry Plant Materials Center, Elsberry Missouri.
- **Native Warm Season Grasses**:
  - 'Alamo' 'Kanlow' 'Cave-in-Rock' switchgrass 9083274 Big bluestem, 'Rumsey' Indiangrass
- **Planting rate**: 50 PLS/linear ft.
- **Non-native Warm Season Grass**
  - 'Freedom' Miscanthus
- **Planting rate:** vegetative rhizomes started in greenhouse planted in RCB 4-replicated plots on 3'x3' spacing**.**
- **Soil Type**: Marion silt loam ,fine, montmorillonitic, mesic, Algaquic hapludalfs, Alfisols.
- **Plots size** : RCB 4-replications, 7 row plots; 36" row spacing(18-ft x 20ft )
- **Fertility**: N applied at 100 lb/acre in single application in spring 2008, 50lb/acre in 2009 ; P and K at high level according to soil test recommendation.
- **Harvest Schedule**: First harvest at seed maturity and subsequently every 6 weeks ending in March/April (~24weeks)




### Annual Precipitation 2007-2009, Jan-July 2010 and 79 Year Average




### Lodging effects and Total Dry Matter Yield(lb/acre) Biomass Production of Warm Season Perennial Grasses




## Conclusion

- Miscanthus had the greatest potential for biomass production , average for 2008-2009 was 24,000lb/acre(12 tons/acre,)
- Kanlow switchgrass was 2nd, average for 2008-2009, at 13,217lb/acre (6.6 tons/acre)
- Kanlow and Alamo switchgrass (lowland) cultivars out performed Cave-in-Rock.
- Rumsey Indiangrass had the greatest potential for lodging from the initial harvest throughout the different times of harvest.
- Weathering did significantly reduce biomass yield in lb /acre. (20 % to 25%)after the December (12 week) to the February (18 week) harvest for 9083274 Big Bluestem, Rumsey Indiangrass, and Kanlow switchgrass.
- Nutrients of Nitrogen ≤ 1% level were at or below this level from the initial harvest . Potassium concentrations decreased in all grasses by the 2nd (6week) harvest.
- Sulfur concentrations were≤ .03% by the 2nd (6 week) harvest for all species.
- Ash levels were < 10% concentration from initial harvest, all species ,except indiangrass ,were< 5% concentration after the 2nd harvest.
- Moisture levels were< 23% level after the 2nd (6 week) harvest for all species ,except Kanlow switchgrass, which was< 23% after the third harvest.
- Rainfall for 2008 and 2009 exceeded long term averages, moisture was not a limiting factor to overall production.
- In general ,for the species listed the best overall harvest time to maximum total yield and to reduce the amount of nutrients and moisture concentrations is between the 2nd ( 6 week) harvest and the 3rd (12 week) harvest; however Miscanthus could be extended to the 4th (18 week) harvest.

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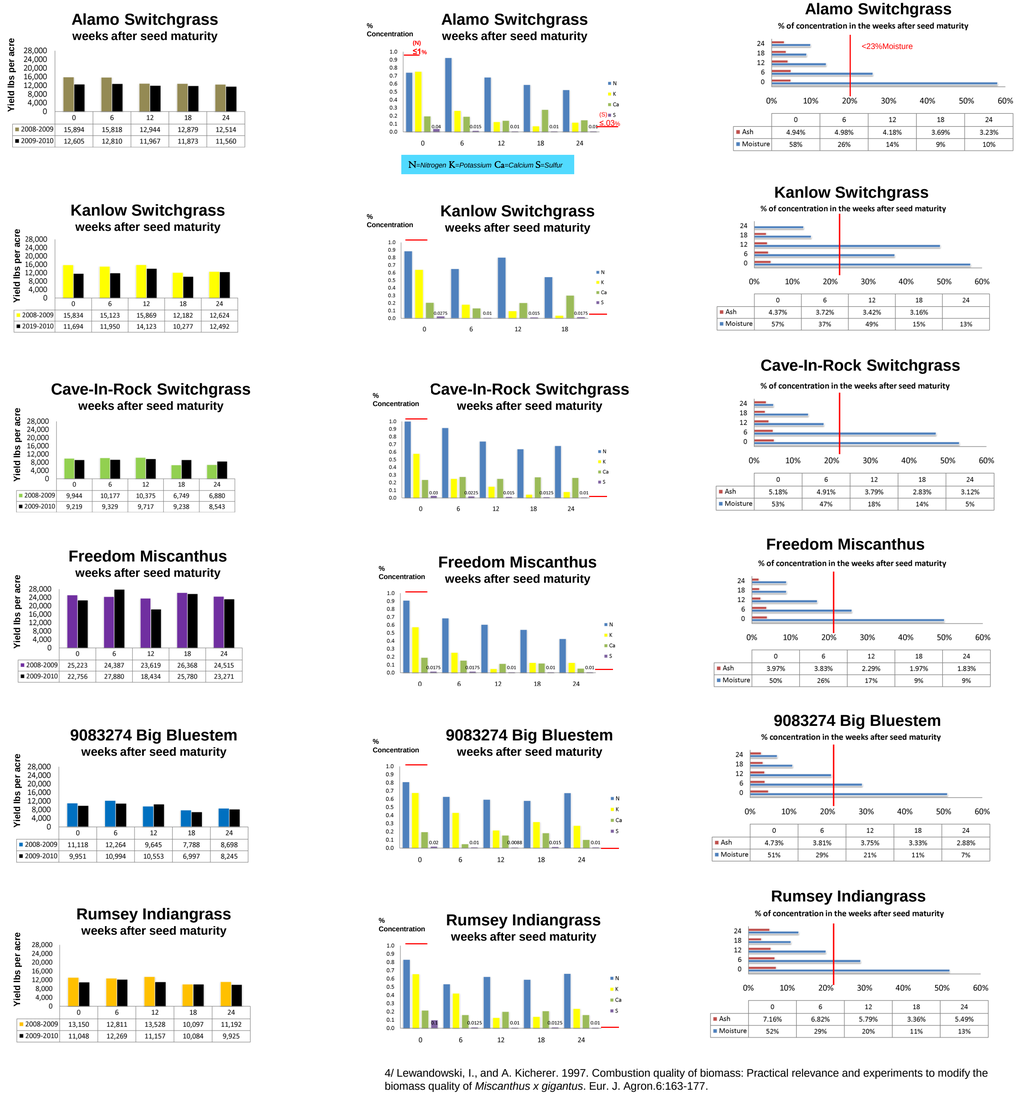
### Nutrient Cycling, percent Moisture and Ash concentration effects on Biofuel Quality of Warm Season Perennial Grasses

Percent Concentrations of N,S, and moisture below red line are acceptable levels




4/ Lewandowski, I., and A. Kicherer. 1997. Combustion quality of biomass: Practical relevance and experiments to modify the biomass quality of *Miscanthus x gigantus*. Eur. J. Agron.6:163-177.