TERRA Field Workplan 2016

Experimental design

Germplasm used for the project

1) Bioenergy association panel (BAP)

----photo period sensitive

----Tall to very tall

----365 lines

----from Clemson SC

2) Biomass RILs

----R10766 X R08331

----Photoperiod insensitive

----semi-dwarf to mod-tall

----about 200 lines (two families)

----From Texas A&M

[What seed treatment?]

Experimental design

- **Field location Ashland Bottoms**
- Randomized Block Design with augmentation: Script for field design
- Field information is here
- Replicate: 4-row plots two experimental replicates
- Genotypes were names with RIL + entry in RIL
- Genotypes were names with PI in BSA
- plot size: row space: 0.762 meters; 3meter row length

Planting information

Plant date: June/17/2016

Replicate: 4 row plots two experimental replicates

Place: ashland

Protect fill: four rows each side of ranges, one range each side of row, and between two experimental blocks, two hybrid cultivars were used as fill, Ceres Blade and Richardson Pacesetter.

Field planting table

Field map for planting (Note,)

planting notes

Ground Control Points

Glue Bricks to Tiles

Check & Clean GCP

Attach GCP to ground?

Experiment management

Weekly meeting

Fertilizer
- 120lbs N,(28-0-0 liquid fertilizer mix of Urea and Ammonium Nitrate) May 2016, 4 lbs of Zn, and 16 lbs of S applied as a tank mix of liquid fertilizer in March of 2016.

Fill around the experiment
- oats, planted June 30, 2016

Weed control
Pre-emerge...]

5.7 oz/ac Callisto

26.5 oz/ac Brawl

40 oz/ac Atrazine

Pest control
Fall armyworm (July/01/2016)

Lorsban Advanced

Harvest

harvest starts on Oct/18th/2016~Oct/25/2016, with the chopper, at the same t to measure the moisture of the fresh sample.

Phenotyping

Traits list (spreadsheet)

Based on Protocols for Agronomic and Physiological Traits at Maricopa

Germination
Germinated at June/20/2016

Germination score (June/27/2016 start and every other day until July/5/2016)

Germination score: on a scale of 0 - 5

- 81 - 100 % - 33 - 40 seeds germinated - 5
- 61 - 80 % - 25 - 32 seeds germinated - 4
- 41 - 60 % - 17 - 24 seeds germinated - 3
- 21 - 40 % - 9 -16 seeds germinated - 2

- 1- 20 % - 1 - 7 seeds germinated - 1
- 0 % No germination - 0

Seedling vigor

started at June/30/2016 and every other day stop at July/16/2016, and July/14/2016 as well as July/16/2016 were based on plot level

recorded as levels 1(low)-5 (high)

Plant height

Start July/15/2016 (Thursday), and will repeat each week

July/21/2016 (Thursday)

July/28/2016

August/04/2016 and August/05/2016, finished at two days

August/11/2016 and August/12/2016, finished at two days

August/18/2016 then stop weekly plant height measure.

Final plant height: The last time plant height measure will be taken before harvest or after maturity.

Seedling color

at June/31/2016

Method Manual

Manually recode the color of seedling at June/31/2016. The values are recorded as green (0), purple (3)

Leaves area index

Date, July.22.2016 (Friday)

Randomly selected 50 plots, bad luck with one empty, so 49 plots were measured, data is here. In the data, WHAT means range and where means plot. LAI is leaves area index. Data file 15 was not good, not will include for further analysis and this plot was replicated as file 16. File 26 and file 27 from same plot, file 26 with one replicate, file 27 with two replicates but without big difference, and file 27 will be used in further analysis

Date, July.29.2016 (Friday)

Cloudy, data after range 29 was missed because storage of LAI 2000 plant canopy analyzer. So forty plots were kept.

Date, August.9.2016 (Tuesday)

Friday raining and weekend raining or cloudy. So data was collected on August/09/2016 not August/05/2016

Sorghum midrib color

Method Manual Use crop ontology http://www.cropontology.org/terms/CO_324:0000057/

Manually recode the color of midrib around August 3-16th 2016. The values are recorded as white (1) and green(2), brown(3)

Flowering time

Once anthesis begins, anthesis will be noted 3 times per week until anthesis ends. Anthesis is defined as when 50% of the plants have one or more anthers showing.

Collecting...

Lodging

A lodging score was taken at 08/17/2016. The lodging score will be recorded as a percentage. 0 means no plant was lodged, 100 indicated all plants completed lodged.

Second time lodging score was taken at 08/25/2016, the break off type of lodging was marked by the data with .1 tail for data, but should not all.

The third time lodging score was taken at Oct./5/2016, the break off type of lodging was marked by the data with .1 tail for data, but should not all.

Stem

including plant height stem width (Diameter) and stem number. stem width was recorded with the third internode diameter (units:mm).

Leaf architecture

Include leaf length, leaf width and leaf angle were phenotyped with the leaves about 1.5 meter or middle part of plant.

Leaf angle → leaf_attachment_angle

PheMU

Goal: Collect data for comparison with manual and UAV phenotyping

Target 3 runs (12pm-4pm) in late July before plants are too tall

Sensors: NDVI, IRT, Sonar

1. Thursday July 21
2. Monday July 25
3. Thursday July 28

Fixed sensors (SmartCrop)

10 sensors total, in 5 neighboring pairs: See map

1. Row 62-63, Range 8 (45251) and 9 (10720) (Blade and Richardson)
2. Row 54-55, Range 15 (10705) and 16 (45242) (R and B)

3. Row 70-71, Range 20 (45245) and 21 (10715) (B and R)
4. Row 54-55, Range 29 (10708) and 30 (10710) (R and B)
5. Row 18-19, Range 35 (10706) and 36 (10707) (B and R)

Six sensors start working on August/24/2016

Planned installation on 08/16/2016

Adjusted sensors position on 08/19/2016

Flights

Flight data log

Directions: Every Tuesday and Friday (also based on weather if have any special condition, please write down what is the special condition, like weather)

TERRA Flights

1. 6-28-2016 TERRA Red Edge 25m 3mps field
2. 7-1-2016 TERRA field Red Edge 21m 2.5mps
3. July 6 (Wednesday), Rich was out, Daljit helped fly, not fly Sandeep's field (Sunny Calm)
4. 7-8-2016 TERRA field Red Edge 21m 2.5mps
5. July 12 (Tuesday) (Windy Cloudy)
6. July 14 Only half of field was usable data. (Problems with Rededge camera)
7. July 15 fixed problem with Rededge camera (Clear Sky Light Wind)
8. July 19 Flight with Rededge (Clear Sky Windy)
9. July 21 Flight with Rededge (Clear Sky Windy)
10. July 26 Flight with Rededge (Clear Sky Light Wind)
11. July 28 Flight with Rededge (Clear Sky Light Wind)
12. August 3 Flight with Rededge (Clear Sky Moderate Wind)
13. August 6 Flight with Rededge (Cloudy Light Wind)
14. August 10 Flight with Rededge (Clear Sky Windy)
15. August 12 Flight with Rededge (Cool Cloudy Windy)
16. August 15 Flight with Rededge (Light Wind Partly Cloudy)
17. August 16 Flight with Rededge (Clear Sky Windy)
18. August 17 Flight with Rededge 24m (Higher flight to fix DSM) (Clear Sky Windy)
19. August 19 Flight with Rededge 24m (Light Wind Clear Sky)
20. August 22 Flight with Rededge (Clear Sky Windy)
21. August 24 Flight with Rededge (Cloudy) (Rededge & Thermal Flight 40m Andrew S1000)
22. August 29 Flight with Rededge (Light Wind Sunny)

23. September 1 Flight with Rededge (Clear Sky Light Wind)
24. September 6 Flight with Rededge (Clear Sky Windy Hot)
25. September 9 Flight with Rededge (Clear Sky Light Wind)
26. September 12 Flight with Rededge (Hot Very High Winds) (Rededge 60m Andrew S1000)
27. September 13 Flight with Rededge (Wet Cluody Cool Light Wind) (Rededge 60m with thermal Andrew S1000)
28. September 15 Flight with Rededge (Wet Partly Cloudy moderate winds)
29. September 20 Flight with Rededge 24m agl (Moderate Winds hot mostly clear sky)
30. September 22 Flight with Rededge 24agl & 43m agl (Hot High Winds Partly Cloudy)
31. September 26 Flight with Rededge 25m agl (Light Wind Clear Sky)
32. September 30 Flight with Rededge 25m agl (Light Wind Clear Sky)
33. Oct. 3 Flight with Rededge 25m agl (Partly Cloudy Moderate Wind)
34. Oct.8 Flight with Rededge & thermal 25m agl (Clear Sky Moderate Wind) (first flight on Matrice 100 not finished because battery)
35. Oct. 12 Flight with Rededge 25m agl (Cool Windy Partly Cloudy)
36. Oct 14 Flight with Rededge 25m agl (Cool, Moderate Winds, Change from overcast to partly cloudy)
37. Oct 31 Flight after harvest with Rededge 21m agl (Windy, Clear Sky)

Cold Tolerance Flights:

1. 7-1-2016 TERRA field Red Edge 21m 2.5mpsuly 1, Rich fly, TERRA field and Sandeep's field
2. 7-8-2016 (Friday), Rich did fly, but not finish because of low computer battery
3. 7-9-2016 Red Edge 21m 2.5mps
4. 7-12-2016 Red Edge 21m 2.5mps (Windy Cloudy)
5. 7-15-2016 Red Edge (Clear Sky Light Wind)
6. 7-19-2016 Red Edge (Clear Sky Windy)
7. 7-21-2016 Red Edge (Clear Sky Windy)
8. 7-26-2016 Red Edge (Clear Sky Light Wind)
9. 7-28-2016 Red Edge (Clear Sky Light Wind)
10. 8-3-2016 Red Edge (11:30am Clear Sky Moderate Wind)
11. 8-6-2016 Red Edge
12. 8-8-2016 Red Edge (14m agl 1.5 mps 4 flights)
13. 8-10-2016 Red Edge: the image looks like was splitted into two parts that may be caused by missing one pass when fly in field (Clear Sky Windy)
14. 8-12-2016 Red Edge (Cool Windy Cloudy)
15. 8-15-2016 Red Edge (Light Wind Partly Cloudy)

16. 8-17-2016 Red Edge (24m agl)(Clear Sky Windy)
17. 8-19-2016 Red Edge (24m agl)(Clear Sky Light Wind)
18. 8-22-2016 Red Edge (24m agl)(1:30pm Clear Sky Windy)
19. 8-24-2016 Red Edge (40m agl S1000 Andrew) (Cloudy)
20. 8-29-2016 Red Edge (24m agl) (Light Wind Clear Sky)
21. 9-1-2016 Red Edge (24m agl) (Light Wind Clear Sky)
22. 9-6-2016 Red Edge (24m agl) (Clear Sky Hot)
23. 9-9-2016 Red Edge (24m agl) (Clear Sky Light Wind Hot)

Data management

Data analysis

- Model the relationship for leaf area index and NDVI
- Model the sorghum plant height with UAV plant height data with nonlinear mixed effect model with nlme package in R, from the model: get following result, plant heights and fitted curves on the original scale, relative growth rates for height, and absolute growth rates for height. Is the happening time of the highest absolute growth rates for height correlated with plant height?
- Model the NDVI change along with sorghum development.
- Modeling biomass with eco-physiological traits and other traits
- 1, Biomass~height + stem width + leaf length + leaf width + leaf angle for individual levels
- 2, Biomass~stem number + height + stem width + leaf length + leaf width + leaf angle for plot levels
- SNP calling for GBS data and construct a genetic map
- QTL mapping
- GWAS (Who analysis the population structure and LD): MLM and MLMM.
- Genomic selection: rrBLUP,

Modeling plant height

Question

- What is the optimized time for biomass sorghum harvest?
- Question for Kevin: How do you handle the shadow when you analysis DNVI from Redadge sensor image? Especially for NDVI?