ALMANAC model parameterization for high biomass bioenergy crops.

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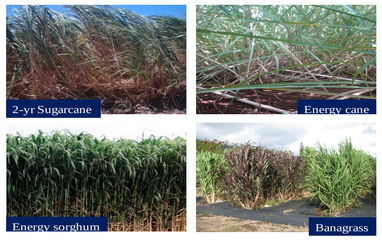
1 Background

- This study is part of a joint ONR/USDA project plan for a resource assessment for high biomass feedstock supply to produce advanced biofuels in Hawaii.
- Four candidate high biomass bioenergy crops: two-year sugarcane, energy cane, energy sorghum and bana/napier grass.



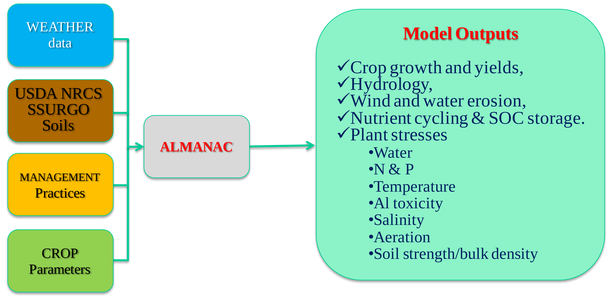
2 Key Tasks

- Design and test sustainable biomass production systems, to include crop rotations with legumes.
- Determine biomass harvest thresholds, and obtain realistic estimates of biomass quantities to be produced by those systems.
- Evaluate spatial and temporal yield variability, and associated production risks.
- Assess long-term environmental impacts on soil erosion, nutrient losses, water/soil quality, SOC storage and greenhouse gas emissions.

3 Strategic Approach

- These novel crops have distinct growth habits but yet poorly understood crop traits or parameters.
- Lack of this knowledge could impede large scale production as it poses socioeconomic and environmental risks.
- Calibrated and tested crop simulation models, such as **ALMANAC** can be adapted to evaluate these novel bioenergy feedstock crops, providing researchers with an effective tool to assess the effectiveness and sustainability of new production systems in a timely and cost-effective manner.
- Field research trials have been established at HC&S, Maui, HI, with parallel trials at Temple and El Paso, TX, to compile key crop parameters required to apply the ALMANAC model.

4 The ALMANAC Model

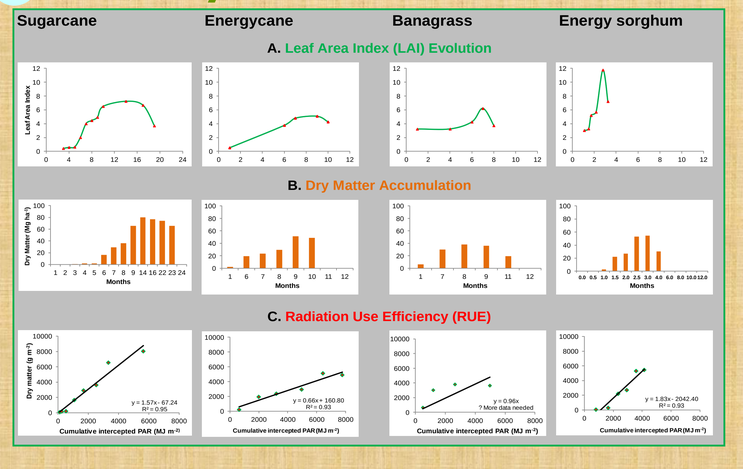


The model operates on a daily time-step and can be formatted for daily, monthly and yearly simulation outputs

5 Gathering Crop Parameter Data

Rooting studies photos: courtesy of Meghan Pawlowski

6 LAI, Dry Matter Evolution, RUE

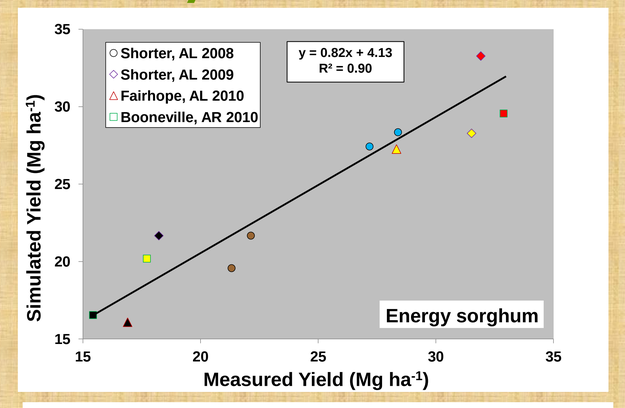


7 Compiled Crop Parameters

1. Growth	Crop Parameter	Symbol	Sugarcane	Energycane	Banagrass	Energy sorghum
	Biomass energy ratio (g m^{-2} MJ^{-1} m^{-2})	WA	1.57	0.66	0.96	1.83
	Heat units required for germination	GMHU	100	100	100	100
	Max. Leaf Area Index (LAI)	DMLA	7.25	5.10	6.20	12.00
	Fraction of growing season when LAI starts to decline	DLAI	0.80	0.80	0.70	0.80
	Light extinction coefficient for Beer's Law	Kc	-0.25	-0.60	-0.44	-0.35
	Max. crop height (m)	HMX	3.60	3.50	3.40	3.60
	Max. root depth (m)	RDMX	>2.00	>2.00	>2.00	>2.00
4. Yield						
	Plant population (x1000)	PLANTPO	155	375	265	120
	Dry matter yield (Mg ha^{-1})	DM	80	50	40	55
	Fraction of water in forage yield	WCY	0.70	0.70	0.65	0.60
	Harvest index	HI	0.90	0.90	0.90	0.90
5. Quality						
	Lignin content (%) (9 months)		8	9	12	11

Caution - Preliminary - One Year Data Only!

8 Preliminary Model Calibration



ALMANAC Model Calibration and Validation: Simulated and measured energy sorghum yield in rainfed (●) and irrigated (●) systems, and at three planting populations: Low – black infill, Medium – yellow infill, and High – red infill.

9 Concluding remarks

- Good progress has been made to gather crop parameters for the four candidate high biomass bioenergy crops, a key step towards ALMANAC model calibration and validation.
- The generated model parameterization data will be invaluable to other researchers working with crop simulation models elsewhere throughout the nation.
- The overall goal is to apply the validated ALMANAC model, along with weather, soil and management practices databases customized for this project, to evaluate high biomass bioenergy crop production systems across various landscapes, in Hawaii and other Pacific Basin Islands.

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