

Effect of water table management on biofuel species growth

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Energycane

- *S. Spontaneum* x com. sugarcane hybrids
- C₄ photosynthetic pathway
- Morphology
 - Rhizomatous perennial grass
 - Deep root system
 - Up to 4.5 m height (Woodard and Prine, 1992)
- High fiber concentration
- Low sucrose content
- High plant population
- Vegetatively propagated
- L 79-1002
 - 1974, Tainan - *S.Spontaneum* x CP 52-68
 - Susceptible to smut disease



“Energycane – the tall, tough, irrigation intimidator”™

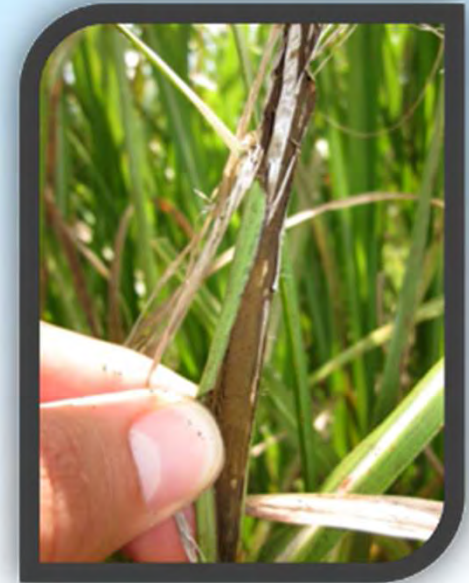


CITRA – Univ. of Florida



Smut disease

Tecan – 1 st ratoon	Number of stools	Number of whips
L79–1002	37	326
US82–1655	1	3
US84-1047	1	3
Energycane - CP	0	0



Arundo donax L.

- **Arundo, giant reed or wild cane**
- **C₃ photosynthetic pathway**
- **Origin**
 - Eastern Asia
- **Morphology**
 - Rhizomatous perennial grass (bamboo-like)
 - Over 8 m height (Everitt, 2004)
 - High lignin
- **DM yield: 30 t ha⁻¹ year⁻¹** (Angelini, 2005)
- **Non native - no viable seed**
- **Vegetatively propagated** (rhizomes / stems)
- **Invasive concerns** (wetlands CA & TX)



Elephantgrass

- ***Pennisetum purpureum* (Schum.)**
- **C₄ photosynthetic pathway**
- **Morphology**
 - Perennial bunchgrass
 - Deep, fibrous root system
 - Up to 7 m height
 - DM yield: 40 Mg ha⁻¹year⁻¹
- **Vegetatively propagated**
- **Merkeron**
 - High yielding x dwarf leafy
 - Released Tifton, GA (Burton, 1989)
 - DM yield: 31 Mg ha⁻¹year⁻¹ (Woodard et al., 1991)





Merkeron Elephantgrass



L 79-1002 Energycane



Erianthus arundinaceum



Arundo donax

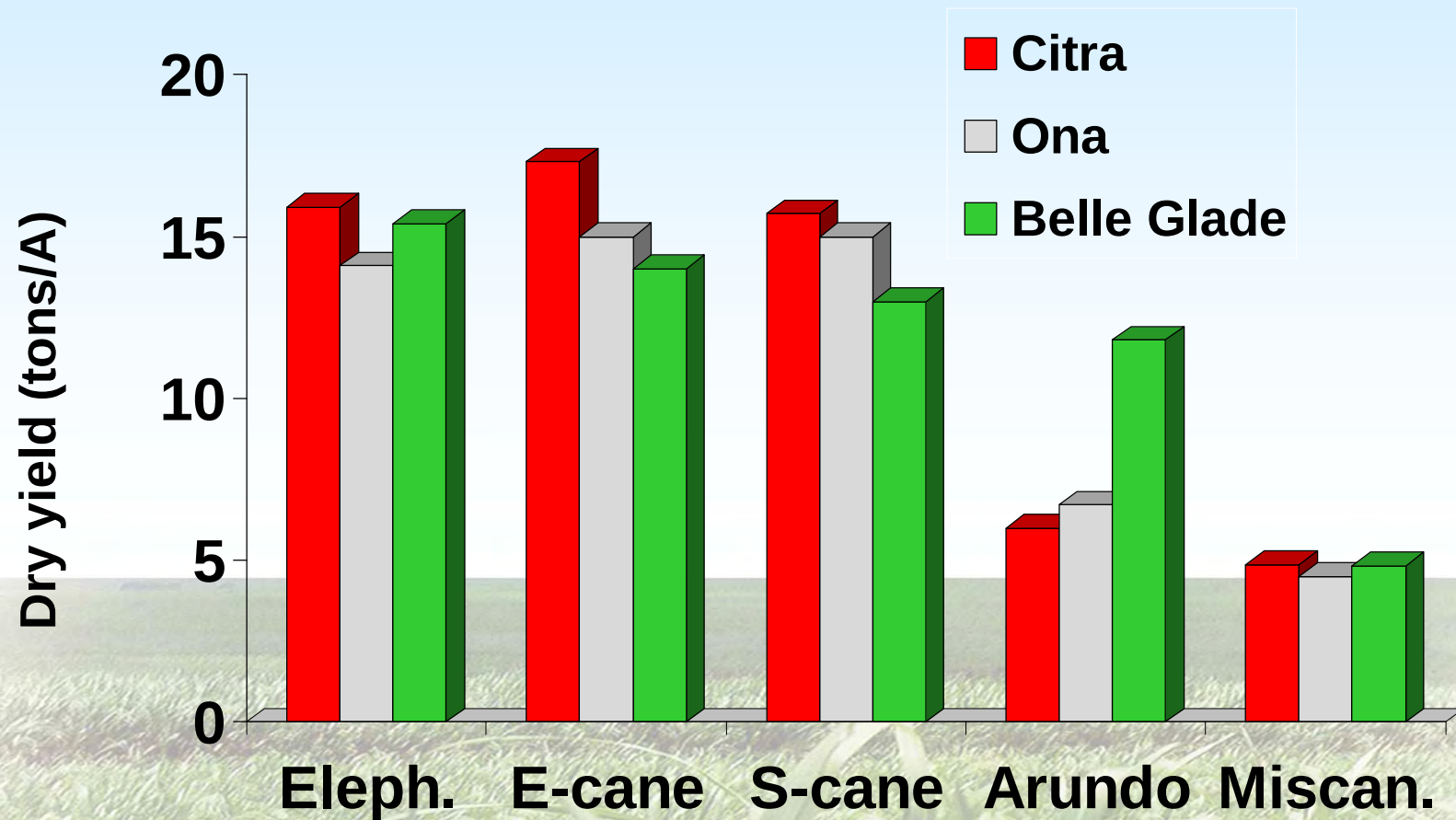


CP 89-2143
Sugarcane



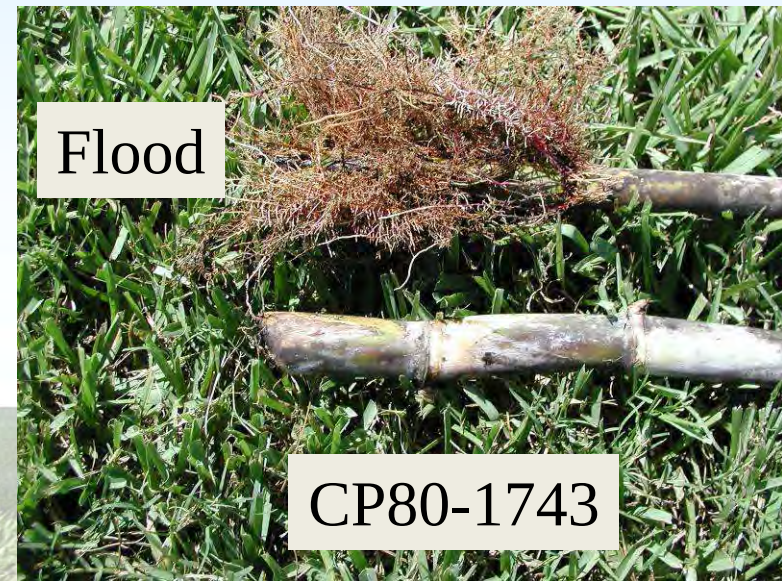
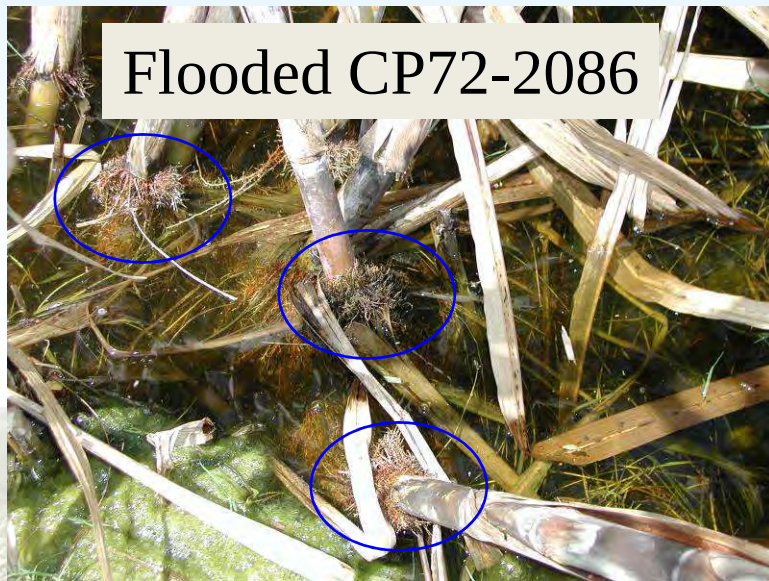
Miscanthus x giganteus

Grass DM Yield at Three FL Locations



Grass species

Morphology changes with flooding



Piping (Aerenchyma in stem)



Photos: USDA-ARS

Feedstock Survey: Sugar Released by Acid Pretreatment followed by Enzymatic Hydrolysis

Feed Stock	Recovered Sugars (measured by HPLC after acid + enzyme treatment)					Total Sugars (g/Kg)	Ash (g/Kg)	Sugars ³ kg/mt DW	Ethanol ⁴ gal/mt DW
	Glucose (g/Kg)	Xylose (g/Kg)	Galactose (g/Kg)	Arabinose + Mannose[1]	Fructose Rt[2] (g/Kg)				
<i>Arundo donax</i>	316	171	45	36	8	576	61	576	91
Elephant Grass	336	164	40	39	7	585	86	585	92
Energy Canes	362	183	44	40	11	641	65	641	101
<i>Erianthus</i>	344	189	47	42	8	631	63	631	99
<i>Miscanthus giganteus</i>	365	201	42	42	5	655	61	655	103
Switch Grass	324	183	40	50	32	629	50	629	99
Cane Bagasse	425	233	31	33	2	724	30	724	114
Sw Sorghum Bagasse	420	186	35	48	18	706	52	706	111
Tropical Corn Bagasse	409	172	45	43	11	681	52	681	107
Avg All Feed Stocks	367	187	41	41	11	648	58	648	100

[1] Mannose co-elutes with arabinose. A small amount of mannose may be present

[2] Peak eluting at fructose retention time (Rt) may include unidentified sugars and/or fructose derived from polymer hydrolysis.

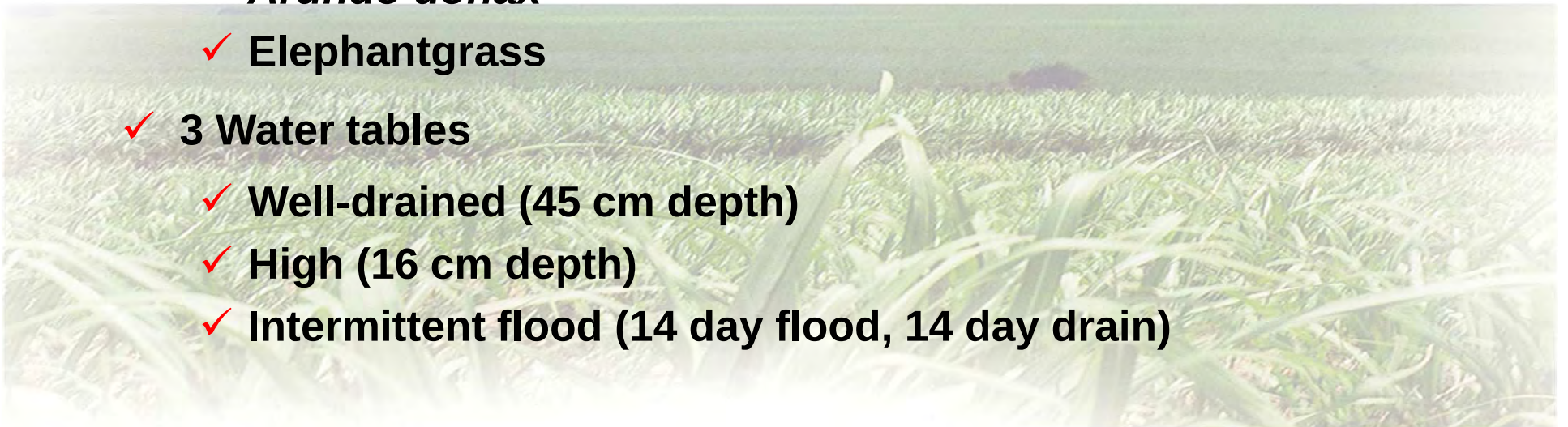
Most free fructose is destroyed during the hemicellulose hydrolysis procedure (145° C, 1h, 2% phosphoric acid).

3 - 90% efficiency conversion from biomass to sugars

4 - 60% efficiency conversion of sugars to ethanol

Experimental Treatments

- ✓ MS project
 - ✓ Begin January, 2011
- ✓ Lysimeters – control water level
- ✓ 4 genotypes:
 - ✓ Energycane
 - ✓ Sugarcane
 - ✓ *Arundo donax*
 - ✓ Elephantgrass
- ✓ 3 Water tables
 - ✓ Well-drained (45 cm depth)
 - ✓ High (16 cm depth)
 - ✓ Intermittent flood (14 day flood, 14 day drain)



Measurements

- ✓ **Growth**

- ✓ **Plant height**

- ✓ **LAI**

- ✓ **Morphology**

- ✓ **Aerenchyma**

- ✓ **Adventitious roots**

- ✓ **Physiology**

- ✓ **Transpiration**

- ✓ **Photosynthesis**

- ✓ **Objective: Evaluate plant growth, morphology and soil changes when biofuel species grown under differing water tables**

