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Performance of Foreign Cane Germplasm on Florida Sandlands [1]

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Introduction

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In Florida, sugarcane is grown on both organic (78%) and mineral "sandland" soils (22%). The Canal Point (CP) breeding program has been very successful in producing sugarcane cultivars for organic soils in Florida (http://edis.ifas.ufl.edu/SC083) . However, the CP program has been less successful in increasing sandland yields, and growers on sandland soils have expressed interest in testing germplasm ("foreign cane") released from programs specifically targeting mineral soils. This EDIS document summarizes field studies established to test foreign cane on Florida sandlands. A set of three experiments was established to evaluate 50 foreign cane genotypes from 11 countries for yield and disease resistance.

Methodology

In experiment 1, 50 clones were planted on a sandy soil at Hilliard Brothers Farms (Table 1). This experiment included 21 clones from the USA (CP, TCP, LCP, US, L), ten clones from China (Yuetang, CGS), five from Colombia (CC, EPC) three from New Guinea (NG), three from Taiwan (ROC), two from the Dominican Republic (CR), two from India (IND, Green German) and one each from Argentina, Brazil, Mexico and the Philippines. In all experiments, sugarcane yields were recorded 12 months after planting by established methods (Gilbert et al., 2006). Field observations of disease were recorded in the spring of each year.

Following plant-cane harvest in experiment 1, 23 high-yielding clones were selected to advance to experiment 2 (Table 2). These clones were planted in single-replicate plots at three mineral soil locations. Field disease observations were recorded in May,

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1999 and final plant-cane yield data were recorded in November, 1999.

Following plant cane harvest of experiment 2, eight high-yielding clones were selected to replant at the same three mineral soil locations in experiment 3 in November, 1999 (Table 3). Field disease and yield data were collected for both the plant-cane (P) and first-ratoon (R) crops in experiment 3. In all experiments, the economic index used by the CP breeding program (Deren et al., 1995) was calculated to rank clones. In experiment 3 clones were ranked based on the sum of plant-cane and first-ratoon economic indices (Table 3).

Results and Discussion

The Yuetang clones in experiment 1 (Table 1) were notable for their large stalk weight and low plant population. Yields of Yuetang 85-1253 were 15 tons/acre of cane more than the second-ranked cultivar. Six Yuetang clones were in the top 13 for cane yield. The large stalk size recorded for the Chinese clones may be indicative of their selection for ease of manual harvesting in China. Economic indices of 11 of 13 clones with CP parentage were in the upper half, with none ranking lower than number 32. LCP 86-454 was notable for high plant population and low stalk weight. Clones originating from the USA tended to have high sucrose concentrations, with 12 of the top 14 sucrose concentration values recorded for these clones. Based on economic index and phenotype, 23 clones (italicized in Table 1) were selected for further evaluation in experiment 2. These included 14 clones from the USA, five from China and one each from Argentina, Colombia, India and New Guinea.

The six most profitable clones in experiment 2 all had at least one CP parent (Table 2). Brown rust (caused by *Puccinia melanocephala* Syd.) was observed in 14 of 23 clones in the field. Rust is a disease with economic impact on sugarcane in Florida and is of particular concern for growers on mineral soils. LCP 85-384 and LCP 86-454 were notable for their high plant populations and low stalk weight, while the Yuetang clones exhibited the opposite growth pattern. Clones with USA origin again had the highest sucrose contents on Florida mineral soils. The top ten sucrose concentration values were recorded for these clones. Four of the Yuetang clones were in the top ten in terms of cane yield: however, their low sucrose content reduced their economic index relative to CP clones. The seven clones selected for inclusion with commercial check CP 78-1628 in experiment 3 are italicized in Table 2.

Genotypes included in experiment 3 (Table 3) were CP 68-350 (used in Texas and Argentina), CP 78-1628 (check, #1 Florida cultivar on sand), CP 73-1547 (check, previous #2 Florida cultivar on sand), LCP 85-384 (#1 cultivar in Louisiana), LCP 86-454 (Louisiana cultivar), TCP 88-3461 (promising genotype in Texas), US 90-0026 (borer-resistant) and TCP 87-3388 (early-sugar cultivar). CP 68-350 produced significantly greater tonnage than the LCP, TCP and US clones in both plant- and first-ratoon crops. TCP 87-3388 was notable for poor tonnage in both crops. The three CP clones selected in Florida ranked higher in tonnage, sucrose yield and economic index than the five foreign canes in both the plant and first-ratoon crops. Rust was observed in the field on the three CP clones as well as on US 90-0026 and TCP 87-3388.

Conclusion

The foreign cane cultivars tested were inferior to the CP clones when grown on mineral soils of Florida. One possible explanation is that Florida mineral soils cropped to sugarcane are generally classified as Entisols or Spodosols Entisols or Spodosols with extremely high sand contents (> 90% sand), whereas the foreign canes tested were selected in mineral soils with higher clay contents. Thus, increased selection efforts of CP germplasm on sandy soils may be a more effective strategy than testing of commercial foreign canes on sandland. However foreign cane should continue to be imported for use as parental material in the basic breeding program to improve sugarcane biomass yields and disease resistance.

References

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Table 1. Yield and economic index data for 50 clones recorded in 1998 plant-cane (Experiment 1).

RANK	**VARIETY**	COUNTRY	STNO †	STWT	SPT	TCA	TSA	ECON. INDEX
		of origin	Stalks/ acre	lb/stalk	Sucrose lb/ton	Cane ton/acre	Sucrose ton/acre	$/acre
1	***FAM 79-432***	*Argentina*	*41961*	*3.33*	*202*	*71*	*7.2*	*1055*
2	***CP 68-0350***	*USA*	*29172*	*3.65*	*230*	*54*	*6.3*	*1052*
3	***YUETANG 85-1253***	*China*	*30609*	*5.58*	*182*	*86*	*7.8*	*974*
4	***CP 70-1133***	*USA*	*44260*	*3.04*	*196*	*68*	*6.7*	*923*
5	***L 90-191***	*USA*	*47709*	*2.05*	*227*	*50*	*5.6*	*873*
6	***LCP 85-384***	*USA*	*34345*	*3.38*	*206*	*59*	*6.1*	*870*
7	***YUETANG 81-4364***	*China*	*25292*	*4.18*	*206*	*53*	*5.5*	*756*
8	***NG 51-065***	*New Guinea*	*30178*	*3.25*	*212*	*49*	*5.2*	*739*
9	***US 90-0026***	*USA*	*41818*	*2.37*	*210*	*50*	*5.2*	*729*
10	***HOCP 85-845***	*USA*	*39518*	*2.23*	*218*	*45*	*4.9*	*702*
11	***US 93-0017***	*USA*	*34201*	*2.38*	*225*	*41*	*4.6*	*683*
12	***TCP 88-3461***	*USA*	*35351*	*2.54*	*215*	*45*	*4.8*	*679*
13	***CP 72-1210***	*USA*	*31040*	*2.57*	*226*	*40*	*4.6*	*674*
14	***CP 87-1248***	*USA*	*33626*	*2.21*	*231*	*39*	*4.5*	*673*
15	***TCP 89-3498***	*USA*	*37219*	*2.33*	*211*	*44*	*4.6*	*622*
16	***YUETANG 63-237***	*China*	*30752*	*3.55*	*190*	*55*	*5.2*	*619*
17	***YUETANG 59-065***	*China*	*25723*	*4.28*	*183*	*57*	*5.2*	*565*
18	***GREEN GERMAN***	*India*	*30321*	*2.61*	*219*	*38*	*4.1*	*551*
19	***CC 84-010***	*Colombia*	*30034*	2.73	*203*	*42*	*4.3*	*545*
20	**MEX 54-81**	Mexico	43111	1.89	204	41	4.2	510
21	***YUETANG 71-359***	*China*	*33626*	*3.58*	*175*	*60*	*5.2*	*505*
22	**US 90-0021**	USA	42105	1.84	210	38	4.0	481
23	***LCP 86-454***	*USA*	*48284*	*1.94*	*196*	*48*	*4.5*	*474*
24	***CP 70-0321***	*USA*	*37075*	*2.21*	*197*	*41*	*4.1*	*460*
25	***CP 78-1628***	*USA*	*32046*	*2.63*	*197*	*42*	*4.1*	*459*
26	***TCP 87-3388***	*USA*	*27016*	*2.60*	*208*	*36*	*3.7*	*439*
27	**NG 96-16**	New Guinea	38369	2.22	183	43	4.1	418
28	**CP 91-0547**	USA	39662	2.13	185	43	4.0	414
29	**ROC 12**	Taiwan	27878	2.96	192	41	3.9	403
30	**ROC 07**	Taiwan	34345	3.20	170	55	4.7	398
31	**CC 82-28**	Colombia	46560	2.21	174	52	4.5	391
32	**CP 92-624**	USA	26441	2.40	211	32	3.4	381
33	**EPC 38-122**	Colombia	43398	2.29	170	50	4.3	359
34	**ROC 03**	Taiwan	29459	2.72	186	40	3.7	336
35	**CR 087220**	Dominican Rep.	19687	3.37	194	34	3.3	320
36	**YUETANG 79-177**	China	26729	3.06	178	41	3.7	302
37	**YUETANG 54-143**	China	25435	2.86	178	37	3.4	296
38	**YUETANG 83-271**	China	20550	3.90	175	41	3.6	280
39	**P-MAG-84-03**	Phillipines	24573	2.31	202	29	2.9	269
40	**US 93-0016**	USA	31327	2.37	178	38	3.3	246
41	**IND 82-241**	India	19544	3.81	175	38	3.3	237
42	**CGS 10 #4**	China	28309	3.34	155	48	3.7	173
43	**CC 84-57**	Colombia	32046	1.75	185	28	2.6	164

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Table 1. Yield and economic index data for 50 clones recorded in 1998 plant-cane (Experiment 1).

44	**YUETANG 71-374**	China	35638	2.78	150	50	3.8	160
45	**US 90-1081**	USA	20837	2.61	180	28	2.5	121
46	**RB 735220**	Brazil	36644	2.50	146	46	3.4	94
47	**CR 87-1001**	Dominican Rep.	32046	2.40	143	39	2.8	3
48	**CC 83-07**	Colombia	24861	2.25	156	29	2.2	0
49	**US 90-1104**	USA	37794	1.81	141	35	2.5	-23
50	**NG 77-75CP**	New Guinea	30178	1.91	124	29	1.8	-162
	LSD $_{0.05}$		15700	0.57	32	25	2.5	526

STNO† = stalk number, STWT = stalk weight, SPT = sucrose concentration, TCA = cane yield, TSA = sucrose yield.

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Table 3. Yield, economic index and disease incidence data recorded in 2000 (plant cane) and 2001 (first ratoon) for eight clones (Experiment 3).

RANK	VARIETY	CROP	STNO†	STWT	SPT	TCA	TSA	EI	DISEASE‡
1	**CP 68-350**	P	33900	3.1	231	52	6.0	990	R3x1, R2x2, R1x4, SMx1
1	**CP 68-350**	R	39188	2.3	236	45	5.4	909	R1x1, SMx1
1	**CP 68-350**	AVG/SUM	36544	2.7	234	48	5.7	1899	
2	**CP 78-1628(CHECK)**	P	38211	2.5	248	46	5.7	1006	R2x4, R1x1
2	**CP 78-1628(CHECK)**	R	42349	1.9	252	40	5.1	876	
2	**CP 78-1628(CHECK)**	AVG/SUM	40280	2.2	250	43	5.4	1882	
3	**CP 73-1547(CHECK)**	P	27442	3.3	233	45	5.3	840	R3x3, R2x2, R1x4
3	**CP 73-1547(CHECK)**	R	29675	2.8	259	40	5.3	947	R1x2
3	**CP 73-1547(CHECK)**	AVG/SUM	28559	3.1	246	43	5.3	1787	
4	**LCP 85-384**	P	45827	1.9	227	43	4.9	745	
4	**LCP 85-384**	R	43690	1.7	261	36	4.7	824	
4	**LCP 85-384**	AVG/SUM	44759	1.8	244	39	4.8	1568	
5	**LCP 86-454**	P	46071	1.7	235	39	4.5	685	
5	**LCP 86-454**	R	44754	1.7	260	37	4.8	851	
5	**LCP 86-454**	AVG/SUM	45413	1.7	247	38	4.7	1536	
6	**TCP 88-3461**	P	30546	2.7	225	40	4.5	651	
6	**TCP 88-3461**	R	32908	2.1	243	34	4.1	641	
6	**TCP 88-3461**	AVG/SUM	31727	2.4	234	37	4.3	1293	
7	**US 90-0026**	P	29809	2.5	224	35	4.0	537	R4x1, R3x2
7	**US 90-0026**	R	31160	2.2	239	32	4.0	620	R1x1
7	**US 90-0026**	AVG/SUM	30484	2.4	231	34	4.0	1157	
8	**TCP 87-3388**	P	28568	2.4	225	33	3.7	501	R3x1, R2x3, R1x3
8	**TCP 87-3388**	R	28736	2.2	256	30	3.9	622	R1x9
8	**TCP 87-3388**	AVG/SUM	28652	2.3	241	31	3.8	1123	
	LSD $_{0.05}$	P	4726	0.3	19	6	0.8	211	
		R	4245	0.3	11	5	0.7	173	

†STNO = stalk number, STWT = stalk weight, SPT = sucrose concentration, TCA = cane yield, TSA = sucrose yield, EI = economic index, units as in Table 2.

‡Disease ratings: R = rust, 4 = most severe rating, x 1 indicates number of plots (out of 18), SM = smut