

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

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

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	Philippines	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
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.

Table 2. Yield, economic index and disease incidence data for 23 clones recorded in 1999 plant cane (Experiment 2).

RANK	VARIETY	STNO [†] Stalks/acre	STWT Lb/stalk	SPT Sucrose lb/ton	TCA Cane ton/acre	TSA Sucrose ton/acre	ECON. INDEX \$/ha	DISEASE [‡]
1	CP 73-1547	27156	3.76	194	52	5.1	621	
2	CP 68-0350	39520	2.89	186	58	5.4	617	R2x1, R3x1
3	CP 70-1133	36175	2.64	198	46	4.7	593	R1x1
4	TCP 88-3461	33722	3.03	192	53	5.0	592	
5	LCP 85-384	44252	1.89	204	41	4.2	507	
6	TCP 87-3388	32706	2.74	195	44	4.3	467	R2x1
7	YUETANG 63-237	30253	3.28	179	49	4.4	420	R3x2
8	US 90-0026	34416	3.06	178	51	4.5	413	R2x1
9	HOCp 85-845	34094	2.13	193	35	3.5	365	R2x1
10	CP 87-1248	31219	2.50	191	39	3.7	361	
11	US 93-0017	30724	2.29	199	35	3.5	358	R1x1
12	CC 84-010	31740	2.57	185	40	3.7	343	R3x2
13	L 90-191	36646	1.76	206	31	3.2	341	
14	GREEN GERMAN	33648	2.50	177	41	3.7	304	R2x2
15	LCP 86-454	46804	1.62	182	38	3.5	288	
16	YUETANG 71-359	33474	2.73	169	44	3.8	284	
17	YUETANG 81-4364	26487	3.77	170	50	4.1	274	R4x1
18	TCP 89-3498	33400	1.96	177	32	3.0	219	
19	YUETANG 85-1253	28494	3.60	152	50	3.9	193	R2x1
20	NG 51-065	25025	3.39	160	42	3.3	155	R3x1
21	FAM 79-432	25521	2.68	172	34	2.9	149	
22	CP 70-0321	30204	1.77	176	26	2.3	97	R3x1
23	YUETANG 59-065	19574	2.98	167	29	2.4	62	R2x1, R3x1
	LSD	7209	0.68	29	14	1.6	348	

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

[‡]Disease ratings: R = rust, 4 = most severe rating, x 1 indicates number of plots (out of 3)

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

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