STALK COLD TOLERANCE OF COMMERCIAL AND CANDIDATE VARIETIES

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INTRODUCTION

The exposure of sugarcane to damaging frosts occurs in over 20 of the 79 sugarcane producing countries, but is most frequent on the mainland of the United States. The frequent winter freezes in the sugarcane area of Louisiana forced the industry to adapt to a short growing season (7-9 months) and a short milling season (about 3 months). In order to measure the post-freeze deterioration of stalks of commercial and candidate varieties, a collaborative study between the LSU AgCenter, Audubon Sugar Institute, St. Gabriel, LA and the USDA-ARS, Sugarcane Research Unit, Houma, LA, at the USDA-ARS Ardoyne Farm on Bull Run Road at Chacahoula, LA.

METHOD

Variety trials for estimating stalk cold tolerance by measuring post-freeze deterioration of stalks of commercial and candidate varieties in the field are routinely planted at the Ardoyne Farm, Houma, LA. Commercial varieties of known cold tolerance are grown as controls. They include, but are not limited to, the following varieties: LCP 85-384 for good stalk cold tolerance and TucCP 77-42 for poor cold tolerance. From 8 to 10 commercial and candidate varieties, including the control varieties, are planted in the late summer or early fall of each year. Planting is done on raised ridges 1.8 m apart. Variety plots are 12-15 m long and 3 rows wide. The experimental design is a randomized complete block with 3 or 4 replications. Plots are cultivated and fertilized according to recommended plantation practices; insecticides are applied as required according to the economic threshold. The cane is allowed to remain in the field until the first freeze of the harvest season of the year following planting (plant-cane crop). Just prior to or immediately following a freeze, samples are removed serially along the center row of each plot. Normally, from 1 to 5 post-freeze samples are taken depending upon the severity of the freeze and post-freeze weather conditions. Each sample consists of 15 stalks cut at the ground by hand but not stripped or topped. All samples are weighed and passed through a pre-breaker. A sub-sample of 2.2 lb (1000 g) of the prepared cane is pressed in a hydraulic press at 2,500 psi for 1 minute, 15 seconds that separates the cane sample into juice and residue (bagasse), both of which are analyzed, the former for Brix by refractometer and sucrose by polarimetry and the latter only for moisture (by drying). The Brix, sucrose, purity and fiber content of the cane are then calculated from these analyses. Then from these data, the estimated yield of theoretical recoverable sugar per ton of cane (TRS/TC) is calculated. Mean stalk weight is calculated by dividing the sample weight by the number of stalks per sample. Juice samples are also analyzed for pH, titratable acidity, mannitol and dextran by the ASI II Method and total soluble polysacharide. When possible, visual ratings are made for both leaf and stalk cold tolerance in the field.

In the current experiment, nine commercial and two candidate varieties were planted at the Ardoyne Farm during the late summer 2008. The commercial varieties included in the study were: LCP 85-384, Ho 95-988, HoCP 96-540, L 97-128, L99-226, L 99-233, HoCP 00-950, L 01-283 and TucCP 77-42 (Argentina). Candidate varieties included in the study were: L 03-371 and HoCP 04-838.

RESULTS AND DISCUSSION

Freezing temperatures that affected the Louisiana sugar industry during the 2009-2010 harvest season occurred for 11 straight nights from January 2 through January 12 with a low reported at Ryan Airport at Baton Rouge of 18°F occurring on January 11 following two nights where the temperatures dipped to 19°F. Freezing conditions prevailed for over 12 hours for each of these three nights. An inspection of the stalks on the morning of January 9 revealed that all internal stalk tissue had been damaged by the previous night's freeze. It was noted that longitudinal cracks appeared on all stalks for each of these three nights when, in fact, all stalk tissue was frozen solid. After thawing, all internal tissue appeared ruptured with a brownish and watery appearance.

Samples were taken the mornings of January 8, 15 and 23. Results for mean stalk weight, brix%cane, sucrose%cane, purity%cane, fiber%cane, yield of theoretical recoverable sugar per ton cane (TRS), pH, titratable acidity (ml 0.1 N NaOH) and total polysaccharides (ppm/brix) are shown in Table 1.

Table. 1. Summary of results of 2009 – 2010 freeze tests[1].

Test	Variety	MSW (lb)	B%C	S%C	P%C	F%C	TRS (lb/ton)	pH	TA	TSP (ppm/Bx)
1	384	2.54	16.15	13.55	87.21	21.00	212.5	5.46	1.89	5,628
2	384	2.36	16.17	13.38	85.57	21.26	207.8	5.54	1.69	6,140
3	**384**	**2.51**	**15.55**	**11.71**	**77.77**	**21.08**	**172.7**	**4.36**	**3.33**	**32,723**
1	988	2.79	16.71	14.33	88.25	18.10	234.0	5.54	1.81	4,634
2	988	2.72	16.70	14.08	86.38	18.16	227.8	5.62	1.73	6,136
3	988	2.51	15.86	12.18	79.08	20.01	183.8	4.73	3.09	20,122
1	540	3.20	16.71	14.05	87.34	20.64	221.4	5.48	1.94	6,183
2	540	3.04	16.76	14.11	86,81	20.19	223.6	5.59	1.95	5,625
3	540	2.86	15.91	11.75	76.41	21.58	170.4	4.48	4.41	35,845
1	128	3.19	16.25	13.89	88.11	20.78	220.5	5.48	2.16	6,317
2	128	3.02	16.31	13.62	85.95	21.36	212.3	5.60	2.05	6,544
3	128	2.87	15.58	11.93	78.76	22.49	174.9	4.78	3.16	16,808
1	226	3.89	16.53	14.22	88.47	17.59	233.7	5.61	1.68	5,015
2	226	3.53	16.37	13.87	86.84	17.96	225.4	5.68	1.59	4,819
3	226	3.71	15.76	11.45	74.61	18.73	169.0	4.29	3.98	43,783
1	233	2.47	17.17	14.98	89.55	18.79	245.1	5.50	2.08	5,372
2	233	2.63	16.73	13.98	85.57	18.78	224.0	5.35	2.38	13,141
3	**233**	**2.34**	**16.20**	**10.73**	**67.83**	**20.21**	**146.9**	**4.12**	**5.84**	**90,158**
1	950	2.75	17.76	15.56	90.55	19.05	254.3	5.49	2.05	4,707
2	950	2.83	17.26	14.50	86.52	19.96	230.1	5.58	1.99	5,481
3	**950**	**2.64**	**16.66**	**12.99**	**80.45**	**21.39**	**195.0**	**4.58**	**3.68**	**15,066**
1	283	2.36	17.42	15.21	90.17	18.35	250.0	5.50	1.92	5,404
2	283	2.30	17.38	14.82	87.79	18.65	240.3	5.57	1.81	6,040
3	283	2.24	16.40	12.51	78.59	19.10	189.9	4.97	2.73	27,730
1	371	2.99	16,87	14.48	88.62	17.84	237.2	5,62	1.54	4,632
2	371	2.72	16.76	14.26	87.36	18.40	231.3	5.73	1.55	4,901
3	371	2.62	16.12	11.67	74.93	19.92	169.6	4.45	3.64	28,127
1	838	2.79	15.69	13.07	87.05	22.72	200.3	5.55	2.17	6,179
2	838	3.04	15.65	12.93	85.83	24.02	194.3	5.64	1.99	6,022
3	838	2.84	15.62	11.78	78.22	22.87	170.5	4.73	3.12	28,385
1	42	3.61	15.58	12.96	85.12	19.10	206.4	5.31	3.19	5,659
2	42	3.23	15.16	11.88	80.23	20.17	181.1	5.34	3.02	12,515
3	**42**	**2.89**	**14.46**	**7.94**	**56.42**	**21.51**	**89.7**	**4.16**	**7.95**	**77,650**

[1] Test 1 = sampled 01/08/10; Test 2 = sampled 01/15/10; Test 3 = sampled 01/23/10; MSW = mean stalk weight; B%C = brix percent cane; S%C = sucrose percent cane; P%C = purity percent cane; F%C = fiber percent cane; TRS = theoretical recoverable sugar per ton of cane; TA = titratable acidity (ml 0.1 N NaOH); TSP = total soluble polysaccharide; bold print shows comparisons with control varieties, LCP 85-384 and TucCP 77-42, and the best commercial variety, HoCP 00-950, and the worst commercial variety, L 99-233, with regards to juice quality parameters.

No differences were noted in stalk weight amongst dates of harvest for all varieties during the sampling period; however, there were differences in stalk weight among varieties as expected (Table 1). There were also significant differences in brix%cane, sucrose%cane, purity%cane, fiber%cane, yield of theoretical recoverable sugar per ton of cane (TRS), titratable acidity (ml 0.1 N NaOH) and total polysaccharide amongst varieties for all sampling dates. There were no differences amongst varieties for pH on the first two sampling dates. Although there was a trend towards lower juice quality between the first two sampling dates, the greatest reduction in juice quality for all varieties occurred between January 15 and 23. There was a significant reduction in all juice quality parameters for all varieties. Based primarily on the percent reduction in TRS and the percent increase in total soluble polysaccharide, HoCP 00-950 showed the best stalk cold tolerance for the varieties included in the test and for the freezing events that occurred in the current test (Table 2). As a result of this test HoCP 00-950 would be classified as resistant.

Three varieties, L 99-226, L 99-233 and TucCP 77-42, showed extremely poor stalk cold tolerance and, as a result of this test, would be classified as susceptible. The eight remaining varieties would be classified as intermediate with four varieties, LCP 85-384, HoCP 96-540, L 03-371 and HoCP 04-838, in a subcategory of intermediate to susceptible because of the increase in total soluble polysaccharide between the January 15 and January 23 sampling dates.

Table 2. Reaction of commercial and candidate sugarcane varieties to subfreezing temperatures based on current tests (based primarily on percent reduction in TRS and percent increase in total soluble polysaccharide).

Resistant	Intermediate	Susceptible
HoCP 00-950	LCP 85-384†	L 99-226
	Ho 95-988	L 99-233
	HoCP 96-540†	TucCP 77-42**
	L 97-128	
	L 01-283	
	L 03-371*†	
	HoCP 04-838*†	

* Candidate varieties; ** Argentine commercial variety resistance; † Subcategory of Intermediate to Susceptible

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