

CULTIVAR AND CROP EFFECTS OF SUGARCANE BULL SHOOTS ON SUGARCANE YIELD IN LOUISIANA

Kenneth A. Gravois¹, Benjamin L. Legendre², and Keith P. Bischoff¹

¹Louisiana State University Agricultural Center, Sugar Research Station, P.O. Box 604, St. Gabriel, LA 70776. ²Louisiana State University Agricultural Center, Cooperative Extension Service, Baton Rouge, LA 70894. (formerly of USDA-ARS, Southern Regional Research Center Sugarcane Research Unit, P.O. Box 470, Houma, LA 70361).

ABSTRACT

Bull shoots are late-sprouting, large-diameter tillers that often appear late in the season in sugarcane (*Saccharum* spp.) grown in south Louisiana. The effect of bull shoots on sugarcane yield has not been assessed in Louisiana. The objectives of this study were to evaluate the cultivar and crop effects of bull shoots on sugarcane yield and yield components. Cultivar effects of bull shoots were evaluated during 1998 and 1999 at the USDA-ARS Ardoyne Farm at Chacahoula, LA. Crop effects of bull shoots were evaluated during 1998 at a test conducted on Joel Landry's farm near Paincourtville, LA. Sugarcane cultivars produced significantly different amounts of bull shoots. Sugarcane cultivars LHo 83-153 and LCP 85-384 produced the least amount of cane yield derived from bull shoots, averaging 3.2 and 4.4 percent of the total cane yield for the two years, respectively. Sugarcane cultivar HoCP 85-845 produced the greatest cane yield derived from bull shoots, 16.1 percent of the total cane yield for the two years. For all cultivars, both sucrose concentration and fiber content were lower for the bull shoots than for the whole stalks. For the test conducted at the Joel Landry Farm, the plantcane crop derived 16.6 percent of its total cane yield from bull shoots, whereas the first-ratoon crop derived 11.8 percent of its total cane yield from bull shoots. For both tests, the overall effect of bull shoots was positive because of the net increase in sucrose yield per unit area. However, bull shoots may have an adverse effect on processing because of added polysaccharides, starch, and color precursors. With the additional costs of transportation and processing and the negative effects on sugar quality, bull shoots may likely have an overall negative effect on overall sugar production.

INTRODUCTION

Bull shoots are late-sprouting, large-diameter tillers that often appear late in the growing season in sugarcane grown in south Louisiana. Bull shoots are also referred to as suckers or water sprouts. Some sugarcane cultivars tend to produce more bull shoots than others, and the problem is more pronounced in some years. Bull shoots are considered to produce additional weight with minimal sucrose concentration adding significant transportation and milling costs.

Sugarcane is clonally propagated for commercial production. In Louisiana, whole stalks and, to a lesser extent, smaller billet pieces are planted in the soil during August and September to begin a cycle of crops. Usually, a plantcane crop and two to three ratoon crops are harvested from a single planting. Because of Louisiana's temperate climate, the crop remains dormant in the winter months following harvest. In the spring, new shoots emerge to begin the subsequent crop. Once a sugarcane crop is harvested, the

roots are physiologically active for only a short while (Baver et al., 1962). The roots cease to function and quickly die. For each new ratoon, a shoot that develops from an underground overwintering bud quickly develops its own root system. Like many grasses, sugarcane relies on tillering to attain a desired plant population. In Louisiana, the tillering period usually ranges from late April through early June. Maximum tillering occurs approximately 500°C d after regrowth (Inman-Bamber, 1994). More tillers are produced than can normally become mature millable stalks. Tiller senescence occurs after the canopy closes beyond 70% interception of photosynthetically active radiation (Inman-Bamber, 1994).

Suckering, or the formation of bull shoots, begins in fields that are six to seven months of age (Hess, 1954). The formation of bull shoots begins in fields where sunlight is able to penetrate to the soil surface. It is common to observe a flush of bull shoots produced after sugarcane has lodged. In Hawaii, this flush of tillers is important to the overall contribution of cane yield. In Mauritius, bull shoots are not cut during hand harvesting and serve as an important beginning toward the next crop cycle. In Louisiana, some cultivars, like HoCP 85-845, can produce bull shoots even when the crop remains erect with a dense canopy. The cultivar CP 72-370 also has a tendency to produce bull shoots in Louisiana. However, the leaf angle of CP 72-370 is extremely erect and may allow enough sunlight to penetrate the canopy, thus allowing bull shoots to form late in the growing season. Salter and Bonnet (2000) indicated that high soil nitrogen level was one of several factors that may contribute to late season sucker production.

The effects of sugarcane bull shoots on sugarcane yield parameters have not been quantified for different cultivars or for different sugarcane crops (plantcane vs first ratoon). Therefore, our objectives were to assess cultivar and crop effects of sugarcane bull shoots on sugarcane yield and yield components.

MATERIALS & METHODS

Tests were conducted in 1998 and 1999 to determine the effect of bull shoots on different sugarcane cultivars at the USDA-ARS Sugarcane Research Unit's Ardoyne Farm at Chacahoula, LA. Data were collected each year from the plantcane crop of the second line trials of the USDA-ARS sugarcane breeding program. Cultivars used as controls in the second line trials (CP 70-321, LHo 83-153, LCP 85-384, and HoCP 85-845) were replicated five times throughout the trials and were harvested from this test for analyses. Each plot was a single row 4.9 m long and 1.8 m wide. The control cultivars in the second line trials were arranged as a randomized complete block design. The soil type was a Commerce silt loam.

In 1998, a test was conducted on Joel Landry Farms in Paincourtville, LA to determine the effect of sugarcane bull shoots on different sugarcane crops (plantcane vs first ratoon). The soil type for this test was also a Commerce silt loam. The cultivar tested was HoCP 85-845 in adjacent fields of a plantcane and first-ratoon crop. The experimental design at this location was a randomized complete block with a split-plot arrangement of treatments. Whole plots were crop, and sub plots were whole stalk and bull shoot treatments. Each plot was a single row 4.9 m long and 1.8 m wide.

The tests conducted at the Ardoyne Farm were harvested on December 17, 1998 and November 23, 1999. The test conducted at the Joel Landry Farm was harvested on December 18, 1998. Just prior to harvest, all stalk types were counted in each plot. For the Ardoyne Farm tests, whole stalks were

counted as well as bull shoots, which were divided into two categories: those stalks greater than one meter and those stalks less than one meter in height. Hand-cut stalk samples of five stalks of each stalk type were harvested and sent to the sucrose laboratory for quality analyses. In some instances, less than five stalks were harvested when stalk type counts were less than five. In the Joel Landry Farm test, stalk counts were done similarly except that the bull shoots were not categorized by height. Ten hand-cut stalks of each stalk type were harvested for analyses in the sucrose laboratory. All samples were cut level with the ground, topped through the apical bud, stripped of leaf material, bundled, and tagged. Bundle weight was recorded upon entry into the sucrose laboratories.

The samples from the Joel Landry farm were processed at the LSU Sugar Research Station sucrose laboratory at St. Gabriel, LA. Fiber content (g/kg) was determined by chopping six stalks with a Jeffco cutter-grinder (Jeffress Brothers Ltd., Brisbane Queensland, Australia), mixing, and taking a 600-g sub-sample for fiber analysis (Tanimoto, 1964). Each sample was pressed with a hydraulic press at 10.35 MPa pressure for one minute to separate the juice from the residue (bagasse). The residue was weighed and then oven-dried for three days at a temperature of 40.5°C. The weight of the dry plug was then recorded. A portion of the crusher juice was analyzed for Brix (percent soluble solids w/w) by refractometer (Chen and Chou, 1993). Pol of the clarified juice was obtained with an automated saccharimeter. Fiber content and sucrose concentration were estimated as described by Gravois and Milligan (1992).

Samples from the Ardoyne Farm were analyzed each year at the USDA-ARS Sugarcane Research Unit's sucrose laboratory at the Ardoyne Farm. Samples were prepared with a prebreaker (Legendre, 1992). For quality analysis, 1000-g samples were pressed with 2.01 MPa pressure for seventy-five seconds. The remaining sample plug was oven-dried for three days at a temperature of 40.5°C. Sucrose concentration (g/kg) was obtained using Brix, pol, and fiber percent cane along with recent modifications to the formula (Legendre, 1992). Using the fibraque correction, New Fiber content = Fiber * 1.3; New Pol = Pol * (100 - New Fiber)/(100 - Fiber); New Brix = Brix * (100 - New Fiber)/(100 - Fiber) * Z, where Z = 1.15 - 0.0018((1000 - Corrected Residue Weight)/10). The factor Z further corrects the Brix to reflect the lower purity of the juice remaining in the pressed core sample. Thus, the Winter-Carp formula is calculated as follows:

$$\text{Sucrose concentration} = 0.5 * ((0.28 * \text{New Pol} - 0.08 * \text{New Brix}) * (100 - (56.67 * \text{New Fiber}) / (100 - \text{New Fiber})))$$

These modifications in the sucrose concentration formula result in lower values and more closely reflect the yield of commercially recoverable sugar as reported by the mills.

Cane yield (Mg/ha) was estimated as the product of stalk number per unit area (no. per m²) and mean stalk weight (kg). Sucrose yield (Mg/ha) was the product of cane yield and sucrose concentration divided by 10.

Data for the USDA Ardoyne Farm experiment were analyzed with the following mixed model:

$$T_{ijkl} = \mu + Y_i + R_{j(i)} + V_k + S_l + YV_{ik} + YS_{il} + VS_{kl} + YVS_{ikl} + E_{ijkl}$$

where μ was the overall mean; Y_i was year i ; $R_{j(i)}$ was replication j within Year i ; V_k was Cultivar k ; S_l was stalk type l . YV_{ik} , YS_{il} , VS_{kl} , and YVS_{ikl} were the interactions, and E_{ijkl} was the residual. Crop and stalk type and their interaction were considered fixed effects, with the remaining effects considered as random effects in the model.

Data for the Joel Landry Farm experiment were analyzed with the following mixed model:

$$T_{ijk} = \mu + C_i + R_{j(i)} + S_k + CS_{ik} + E_{ijk}$$

where T_{ijk} is observation j in crop i , of stalk type k ; μ is the overall mean; C_i is crop i ; S_k is stalk type k ; CS_{ik} is stalk type by crop interaction; and E_{ijk} is the residual. Replication was considered a random effect, and crop and stalk type were considered fixed effects in the model. Means separation techniques were based on LSD ($P=0.05$).

A separate experiment was conducted in 1986 to determine the effect of date of sampling and sucrose concentration on stalk density. Five experimental clones from the L84 assignment series and the control cultivar CP 65-357 were sampled from the infield tests at the St. Gabriel Research Station. Stalk density and sucrose concentration were evaluated for each cultivar on August 13, 1986; October 2, 1986; and December 1, 1986. Stalk density (g/cm^3) was estimated based on stalk height (cm), stalk diameter (cm), and stalk weight (g) measurements from five stalks. Stalk volume was estimated as: $\pi * \text{stalk height} * (\text{radius})^2$. Stalk density was estimated as stalk weight/stalk volume. Sucrose concentration was estimated as described by Gravois and Milligan (1992). Partial correlation coefficients among the traits were obtained after adjusting for date and replication effects in the model.

RESULTS & DISCUSSION

For the tests conducted at the Ardoyne Farm, both sugarcane cultivars and stalk types differed significantly for all traits (Table 1). Based on cane yield in 1998, the cultivar HoCP 85-845's total bull shoot cane yield was 26.0 Mg/ha, which was 21.5 percent of the total cane yield for that cultivar (Table 2). In contrast, only 2.3 Mg/ha or 2.1 percent of the total cane yield of the cultivar LHo 83-153 was attributed to bull shoots. LCP 85-384 is the most widely grown cultivar in Louisiana, harvested on 71 percent of the state's 2000 acreage (Louisiana Cooperative Extension Service Census 2000). The effect of bull shoots on LCP 85-384 was minimal. Only 6.6 and 2.1 percent, in 1998 and 1999, respectively, of LCP 85-384's total cane yield was contributed by bull shoots, with the majority of bull shoots being under one meter in 1998. In 1999, LCP 85-384 was the cultivar with the least amount of cane yield derived from bull shoots.

The effect of crop on bull shoot production was evaluated in the 1998 test conducted at the Joel Landry Farm. HoCP 85-845 stalk type (whole stalks, bull shoots, and total stalks) was significantly different for all sugarcane traits (Table 3). Crop (plantcane vs. first ratoon) effects were significant for sucrose yield, sucrose concentration, stalk number, stalk weight, and fiber content. Sucrose yield, sucrose concentration, and stalk weight means of the bull shoots were significantly higher for the plantcane crop than

for the first-ratoon crop (Table 4). Conversely, fiber content of the bull shoots was significantly lower for the plantcane crop than for the first-ratoon crop. Similar to the results of the Ardoyne Farm test, the bull shoots had a lower sucrose concentration and fiber content compared to the whole stalks. In the Joel Landry Farm test, bull shoots accounted for 16.6 and 11.8 percent of the total cane yield in the plantcane and first-ratoon crops, respectively. The overall effect of bull shoots on sugarcane production was positive when assessed by sucrose yield for both plantcane and first-ratoon crops.

The production of sugarcane is measured by the field cane yield produced per unit area. The quality of that cane yield is measured by the sucrose concentration. In sugarcane produced in Louisiana, the tops and side leaves of the stalks are removed either by controlled agricultural burns or mechanically by extractor fans in combine harvesting systems. Tops and side leaves can decrease sugarcane quality if processed with whole stalks of sugarcane (Ivin and Doyle, 1989).

In a combine harvesting system, short bull shoots would likely be easily extracted with the tops and side leaves through the extractor fan systems. Some portion of the tall bull shoots would likely have a greater chance of being discarded through the extractor fans because of their lower sucrose concentration, which makes these stalk portions less dense than the whole stalks. This premise is supported by the data collected in the 1986 stalk density study. As expected, sucrose concentration significantly increased for each sampling date (August through December). Likewise, stalk density significantly increased for each sampling date: 0.95 g/cm³ in August, 1.06 g/cm³ in October, and 1.13 g/cm³ in December. As the sucrose concentration of the stalks increased, stalk density increased. There was no variety x date interaction, indicating that all varieties followed this pattern. The lower stalk density of the bull shoots would make separation of the bull shoots from the whole stalks more achievable through an air flow fan extractor system. However, as noted in these studies, the bull shoots had larger stalk diameters. Bull shoot billet pieces would likely weigh more than whole stalk billet pieces of similar length, which would tend to offset the stalk density differential between the two stalk types.

In a whole stalk harvesting system, both short and tall bull shoots would be harvested and sent to the factory, although some of the shorter bull shoots would not carry over to the heap. Since bull shoots are living green shoots, burning would have a minimal effect on reducing the cane yield derived from bull shoots. The increase in cane yield is offset by a lower sucrose concentration for the bull shoots. However, the overall effect of bull shoots as measured by sucrose yield was positive in the Ardoyne Farm test for each cultivar in both 1998 and 1999 and in the Joel Landry Farm test in 1998. Other economic factors would tend to diminish the positive effect of bull shoots on sucrose yield. First, both the factory and grower are incurring transportation costs to what is essentially poor quality cane. The overall effect of bull shoots at the factory would be to lower both sucrose concentration, a negative aspect, and fiber content, a positive aspect. While the overall effect of bull shoots on sucrose yield in the field is positive, bull shoots may have an adverse effect on processing because of added polysaccharides, starch, and color precursors. With the additional costs of transportation and processing and the negative effects on sugar concentration, bull shoots may likely have a negative effect on overall sugar production.

REFERENCES

1. Baver, L.D., H.W. Brodie, T. Tanimoto, and A.C. Trowse. 1962. New approaches to the study of cane root systems. *Proc. Int. Soc. Sugar Cane Technol. Congr.* 11:248-252.
2. Chen, J.C.P. and C.C. Chou. 1993. *Meade-Chen Cane Sugar Handbook*, 12th ed. John Wiley and Sons, Inc.
3. Gravois, K.A. and S.B. Milligan. 1992. Genetic relationships between fiber and sugarcane yield components. *Crop Sci.* 32:62-67.
4. Hess, J.W. 1954. The influence of suckers on the yield of sugarcane. *Sugar Journal* 16:25-31.
5. Inman-Bamber, N.G. 1994. Temperature and seasonal effects of canopy development and light interception of sugarcane. *Field Crops Res.* 36:41-51.
6. Ivin, P.C. and C.D. Doyle. 1989. Some measurements of the effect of tops and trash on cane quality. *Proc. Australian Soc. Sugar Cane Technol.* 11:1-7.
7. Legendre, B.L. 1992. The core/press method of predicting the sugar yield from cane for use in payment. *Sugar J.* 54(9):2-7.
8. Salter, B. and G.D. Bonnett. 2000. High soil nitrate concentrations during autumn and winter increase suckering. *Proc. Australian Soc. Sugar Cane Technol.* 22:322-327.
9. Tanimoto, T. 1964. The press method of cane analysis. *Hawaii, Plant. Rec.* 57(2):133-150.

Table 1. Mean squares from the analysis of variance conducted on experiments at the USDA Ardoyne Farm during 1998 - 1999.

Source	df	Sucrose yield	Cane yield	Sucrose concentration	Stalk number	Stalk weight	Fiber content
		(Mg/ha) ²	(Mg/ha) ²	(g/kg) ²	(No./ha) ²	(kg) ²	(g/kg) ²
Year	1	5.1	2210.2*	3653.7*	11628333.5	1.81	11744.5
Rep(Year)	8	1.5	318.0**	393.7**	100162708.8	0.45**	5142.9**
Cultivar	4	6.3**	762.7**	602.4**	569034650.2**	0.90**	13931.3**
Stalk Type	3	1682.1**	91995.8**	139204.9**	42818341556.0* *	8.83**	16575.4**
Year*Cultivar	3	1.3	69.2	1014.0**	1880417458.9	0.93**	14762.6**
Year*Stalk Type	3	2.5*	340.9**	26.6	5095687.6	0.01	958.9
Stalk Type*Cultivar	12	7.7**	511.2**	416.1**	675754568.8**	0.13**	2738.9**
Year*Stalk Type*Cultivar	9	2.0*	245.6**	230.1**	124110538.6	0.35**	5669.8**
Pooled error	181	0.9	85.8	51.3	67399867.3	0.05	1072.0

Table 2. Trait means by year and cultivar for the 1998-1999 USDA Ardoyne Farm tests

-----1998-----						
Cultivar	Sucrose yield	Cane yield	Sucrose concentration	Stalk number	Stalk weight	Fiber content
	(Mg/ha)	(Mg/ha)	(g/kg)	(No./ha)	(kg)	(g/kg)
<i>Bull Shoots (Short)¹</i>						
CP 70-321	0.095	4.9	19.3	9639	0.46	164.8
CP 72-370	0.003	4.4	0.7	11432	0.39	168.8
LHo 83-153	-0.006	1.1	-5.7	4707	0.26	156.8
LCP 85-384	-0.001	4.6	-0.2	12328	0.42	152.6
HoCP 85-845	-0.019	6.9	-2.8	15018	0.46	146.5
LSD(0.05)	NS	NS	2.3	NS	NS	10.0
<i>Bull Shoots (Tall)¹</i>						
CP 70-321	0.183	5.8	31.6	6052	0.92	163.3
CP 72-370	0.560	14.8	40.4	9863	1.29	164.5
LHo 83-153	0.007	1.2	5.9	1121	0.21	134.5
LCP 85-384	0.073	3.7	19.8	4483	0.66	130.9
HoCP 85-845	0.701	19.1	36.7	13225	1.46	165.3
LSD(0.05)	0.500	12.9	10.6	NS	0.35	62.9
<i>Bull Shoots (Total)</i>						
CP 70-321	0.278	10.7	26.0	15691	0.74	163.7
CP 72-370	0.447	19.2	23.3	21295	0.96	165.6
LHo 83-153	0.008	2.3	3.6	2690	0.17	133.8
LCP 85-384	0.082	8.3	9.9	15916	0.49	125.8
HoCP 85-845	0.697	26.0	26.8	28244	1.21	160.3
LSD(0.05)	NS	NS	8.4	NS	NS	60.8
<i>Whole Stalks</i>						
CP 70-321	11.276	93.5	120.6	59625	1.56	173.1
CP 72-370	12.354	103.9	118.9	71505	1.46	178.1
LHo 83-153	13.983	109.5	127.7	81367	1.36	164.0
LCP 85-384	14.850	116.2	127.8	85178	1.37	159.9
HoCP 85-845	11.120	94.8	117.3	66349	1.43	191.8
LSD(0.05)	NS	20.5	5.3	16206	0.14	9.1
<i>Total Stalks</i>						
CP 70-321	11.545	104.2	110.8	75316	1.48	172.1
CP 72-370	12.801	123.1	104.0	92800	1.38	176.2
LHo 83-153	14.064	111.8	125.8	84057	1.34	162.0

LCP 85-384	14.977	124.5	120.3	101094	1.29	157.7
HoCP 85-845	11.814	120.8	97.8	94593	1.38	185.0
LSD (0.05)	NS	19.4	4.8	15191	0.11	8.6

Table 2. cont'd.

-----1999-----						
Cultivar	Sucrose yield (Mg/ha)	Cane yield (Mg/ha)	Sucrose concentration (g/kg)	Stalk number (No./ha)	Stalk weight (kg)	Fiber content (g/kg)
<i>Bull Shoots (Short)¹</i>						
CP 70-321	0.053	2.3	23.0	12553	0.20	136.5
LHo 83-153	0.016	1.8	8.9	13001	0.12	137.3
LCP 85-384	0.013	1.1	11.7	8966	0.13	127.3
HoCP 85-845	0.012	3.4	3.6	12777	0.29	133.2
LSD(0.05)	0.015	1.2	5.4	NS	0.10	6.8
<i>Bull Shoots (Tall)¹</i>						
CP 70-321	0.069	2.2	31.3	4707	0.57	112.6
LHo 83-153	0.083	1.9	43.8	2017	0.95	131.8
LCP 85-384	0.032	1.2	26.5	1569	0.48	73.1
HoCP 85-845	0.246	8.3	29.6	16139	0.59	136.6
LSD(0.05)	0.095	2.2	NS	6158	NS	NS
<i>Bull Shoots (Total)</i>						
CP 70-321	0.114	4.5	25.3	14571	0.36	110.6
LHo 83-153	0.106	3.7	28.7	15019	0.62	134.8
LCP 85-384	0.042	2.3	18.4	6950	0.30	73.3
HoCP 85-845	0.260	11.7	22.2	28917	0.52	135.5
LSD(0.05)	0.106	3.4	13.6	10485	NS	56.7
<i>Whole Stalks</i>						
CP 70-321	8.823	64.4	137.0	55814	1.15	145.6
LHo 83-153	11.846	85.1	139.2	75539	1.13	133.6
LCP 85-384	14.058	105.3	133.5	91678	1.16	151.8
HoCP 85-845	12.228	97.9	124.9	69487	1.40	157.0
LSD(0.05)	3.390	26.1	1.9	14738	NS	NS
<i>Total Stalks</i>						
CP 70-321	8.991	68.9	130.5	70385	1.10	143.6
LHo 83-153	11.935	88.8	134.4	90558	1.11	133.5
LCP 85-384	14.117	107.6	131.2	98628	1.14	150.2
HoCP 85-845	12.483	109.6	113.9	98404	1.31	154.7

LSD(0.05)	3.140	27.3	2.2	13001	NS	NS
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¹ Length of short bull shoots was under one meter, and the length of tall bull shoots was over one meter.

Table 3. Mean squares from the analysis of variance conducted on plantcane and first ratoon crop experiments at the Joel Landry Farm test during 1998.

Source	df	Sucrose yield	Cane yield	Sucrose concentration	Stalk number	Stalk weight	Fiber content
		(Mg/ha) ²	(Mg/ha) ²	(g/kg) ²	(No./ha) ²	(kg) ²	(g/kg) ²
Crop	1	9.6	59.0	924.5**	939062230.0**	0.10**	226.8*
Rep(Crop)	4	2.3*	300.3**	43.8	140123014.0**	0.01**	70.8
Stalk Type	2	192.8**	13142.1**	10361.7**	11801044408.0**	0.34**	3793.4**
Crop*Stalk Type	2	2.2*	73.4	3.5	151015272.0**	0.01	101.0
Pooled error	8	0.4	32.1	53.0	14515518.0	0.001	34.1

Table 4. Trait means by crop for the Joel Landry Farm test conducted during 1998¹.

Stalk Type	Sucrose yield (Mg/ha)	Cane yield (Mg/ha)	Sucrose concentration (g/kg)	Stalk number (No./ha)	Stalk weight (kg)	Fiber content (g/kg)
<i>Plantcane</i>						
Whole stalk	9.35	82.5	113.3	76959	1.06	194.5
Bull shoots	1.55	16.4	94.7	23909	0.68	138.6
Total	10.90	98.9	110.2	100868	0.97	181.5
LSD (0.05)	1.83	16.9	18.3	8490	0.09	5.1
<i>First ratoon</i>						
Whole stalk	11.59	92.0	126.0	95639	0.96	195.1
Bull shoots	0.59	12.3	48.3	26898	0.44	154.9
Total	12.18	104.3	116.8	122537	0.85	186.0
LSD (0.05)	0.52	6.7	14.5	8781	0.09	18.0

¹LSD values to compare two main-plot (crop) means at the same or different sub-plot (stalk type) treatments are 1.77 Mg/ha for sucrose yield, 5.7 g/kg for sucrose concentration, 7179 No./ha for stalk number, 0.06 kg for stalk weight, and 5.9 g/kg for fiber content.