

THE 2001 LOUISIANA SUGARCANE VARIETY SURVEY

B. L. Legendre and K. A. Gravois
St. Gabriel Research Station and Sugar Research Station

A sugarcane variety survey was conducted during the summer of 2001 by County Agents in the 24 sugarcane growing parishes of Louisiana to determine the variety makeup and distribution across the sugarcane belt in the State. The information presented in this report was summarized from those individual parish surveys.

Agents in each sugarcane-producing parish collected acreage figures by variety and crop year from growers in their respective parishes. Ten varieties were named in the survey. They were: CP 65-357; CP 70-321; CP 72-370; CP 74-383; CP 79-318; LCP 82-89; LHo 83-153; LCP 85-384; HoCP 85-845; and HoCP 91-555. Crop-year was divided into four categories. They were: plant-cane, first-stubble, second-stubble and third-stubble and older crops. Some information was also collected from the local Farm Service Agency office when the Agents had difficulty in obtaining all the needed information from the growers. Since this information was collected during the growing season and included input from many persons, acreages may differ from the final total crop acreage figures collected at harvest.

Actual acreages at harvest for each parish, regional totals, and the statewide total are shown in Table 1. Figure 1 shows the parishes in which sugarcane is grown in the State. The statewide total of acreage reported in the survey was 482,080 acres although the final acreage reported by Agents in December 2001 was 493,773 acres. It is important to note that the total acreage of 482,080 is not the "official" total sugarcane acreage in Louisiana; however, it does represent approximately 97.6% of the final reported acreage. Total acres for the 2001 survey for each Region based on the 493,733 acres for the State were as follows: 211,175 acres for the Teche Region; 174,514 acres for the River-Bayou Lafourche Region; and 108,084 acres for the Northern Region.

The estimated statewide sugarcane acreage in percent by variety and crop year is shown in Table 2. The leading variety for 2001 was LCP 85-384, with 78% of the total acreage followed by CP 70-321 with 8% and HoCP 85-845 with 7%. These three varieties, along with HoCP 91-555, are the only four varieties currently recommended for commercial planting in Louisiana (Legendre 2001). LCP 85-384 has been the leading variety since 1998 when it occupied 43% of the state's acreage (Table 7). No other variety occupied more than 1% in the current survey (Table 2). Only two varieties, LCP 85-384 and HoCP 91-555, showed an increase in the acreage grown in 2001 when compared to the previous year (Table 7). LCP 85-384, released for commercial planting in 1993, is the first variety to reach more than 70% of the total acreage since CP 65-357, released in 1973, when it occupied 71% of the acreage grown in the early 1980's. LCP 85-384 is a high yielding, excellent stubbling variety. The variety produces a large number of small stalks and consistently out yields the other three recommended commercial varieties in tons of cane and sugar per acre.

In recent years, there has been a tendency to increase the number of years of a crop cycle because of better stubbling varieties, particularly LCP 85-384 and HoCP 85-845, and relatively mild winters in both 1998 and 1999. Whereas the normal crop cycle consisted of a plant-cane

and two stubble crops, many growers today are now keeping third- and older stubble, extending their crop cycle to four or five years. In 2001, 19.1%, or more than 93,000 acres, was in third- or older stubble (Table 2), an increase of 8,000 acres from the previous year (Legendre and Gravois 2000). There was also a significant increase from 25.2% to 28.5% in the amount of cane kept as second-stubble from 2000 to 2001, respectively. Conversely, this meant that there was less plant-cane in 2001 (23.6%) when compared to the amount of plant-cane in 2000 (27.8%). Table 3 shows the distribution of plant-cane and stubble crops by region. The percentage of the crop made up by plant-cane, first-stubble, second-stubble and third- and older stubble varied from region to region with the Northern Region having the lowest percentage of plant-cane but the highest percentages of first- and second-stubble crops.

The percentage in sugarcane acreage by variety and crop year for the three regions is shown in Tables 4, 5 and 6. LCP 85-384 is the leading variety for all three regions. Its percentages range from 75% in the River-Bayou Lafourche Region to 79% in both the Teche and Northern Region. CP 70-321 is the second leading variety in both the Teche Region (12%) and Northern Region (10%) followed by HoCP 85-845 with 5% in both regions while HoCP 85-845 is the second leading variety in the River-Bayou Lafourche Region (12%) followed by CP 70-321 with 4%. No other variety occupies more than 2% of the total area in any of the Regions. It is interesting to note that the percentage of planted area for LCP 85-384 for both the plant-cane and first-stubble crops generally exceeded 80% for all three regions in the 2001 survey.

Sugarcane variety trends over the last five years are shown in Table 7. Only two varieties, LCP 85-384 and HoCP 91-555, increased in 2001 from the previous year by 7 and 1 percentage points, respectively. All other varieties either decreased in area or remained the same from the previous year. CP 70-321 had the largest decrease at 5 percentage points. HoCP 91-555, released in 1999, increased in planted area in all regions from the previous year (Tables 4, 5 and 6) but still occupies only 1% of the total area grown to sugarcane in the state. The acreage planted to HoCP 85-845 had shown an upward trend from 1997 until 1999; however, the acreage decreased by 1 percentage point between 2000 and 2001.

It is anticipated that LCP 85-384 will continue to gain in popularity for the near term because of its superior yielding ability in tons of cane and sugar per acre and will remain the top variety in the state until comparable or superior varieties are released for commercial production from the breeding program. It is further anticipated that the remaining varieties will continue to decrease in total acreage with the possible exception of HoCP 91-555. This variety is being considered as a possible alternative to LCP 85-384 by some growers; however, it is not anticipated that this variety will ever gain the acceptance by growers as did LCP 85-384. From outfield test data, HoCP 91-555 is a high yielding, good stubbling variety (Guillot *et al.* 2002). It is mostly erect in growth habit and suited to both soldier and combine harvesting systems; whereas, LCP 85-384 frequently lodges and is brittle and difficult to harvest when lodged. It is better suited for combine harvesting.

Acknowledgments

We acknowledge the assistance of the County Agents for soliciting the sugarcane variety information published in this survey. We also want to thank the sugarcane producers that took the time and effort to respond to the survey from their Agents.

References

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Table 1. Estimated total sugarcane acres by parish and region for 2001¹.

Teche Region		River-Bayou Lafourche Region		Northern Region	
Parish	Acres	Parish	Acres	Parish	Acres
Acadia	4,679	Ascension	15,303	Avoyelles	21,942
Calcasieu	6,058	Assumption	41,876	East Baton Rouge	530
Cameron	500	Iberville	36,224	Evangeline	2,474
Iberia	63,537	Lafourche	31,525	Pointe Coupee	31,566
Jeff Davis	8,400	St. Charles	2,750	Rapides	14,225
Lafayette	16,319	St. James	25,236	St. Landry	21,888
St. Martin	36,100	St. John	10,700	West Baton Rouge	15,459
St. Mary	44,026	Terrebonne	10,900		
Vermillion	32,056				
Total	211,175	Total	174,514	Total	108,084
Total all regions: 493,773					

¹ Estimates are based on 2001 variety survey information from County Agents.

Table 2. Estimated statewide sugarcane acreage percentage by variety and crop year, 2001¹.

Variety	Plant-Cane	First-Stubble	Second-Stubble	Third-Stubble And Older	Total
	-----%-----				
CP 65-357	<1	<1	1	2	1
CP 70-321	1	7	12	13	8
CP 72-370	<1	1	1	<1	1
CP 74-383	<1	<1	<1	<1	<1
CP 79-318	0	<1	<1	0	<1
LCP 82-89	<1	1	2	2	1
LHo 83-153	<1	1	1	2	1
LCP 85-384	88	81	72	72	78
HoCP 85-845	5	7	9	8	7
HoCP 91-555	4	1	<1	<1	1
Others	<1	<1	1	1	1
Total Acres	120,072	140,687	139,520	93,494	493,733
Percent Total Crop (%)	23.6	28.8	28.5	19.1	

¹Based on 2001 variety survey information from County Agents.

Table 3. Estimated sugarcane distribution by Region and crop year, 2001¹.

Crop Year	Teche	River Bayou Lafourche	Northern	State Total
Plant-Cane Acres	51,526	47,469	21,077	120,072
%	24.4	27.2	19.5	23.6
First-Stubble Acres	55,117	49,038	36,532	140,687
%	26.1	28.1	33.8	28.8
Second-Stubble Acres	60,185	47,991	31,344	139,520
%	28.5	27.5	29.0	28.5
Third-Stubble and Older Acres	44,347	30,016	19,131	93,494
%	21.0	17.2	17.7	19.1
Total Acres	211,175	174,514	108,084	493,773

¹Based on 2001 variety survey information from County Agents.

Table 4. Estimated Teche Region acreage percentage by variety and crop year, 2001¹.

Variety	Plant-Cane	First-Stubble	Second-Stubble	Third-Stubble And Older	Total
CP 65-357	<1	0	1	1	<1
CP 70-321	8	10	15	16	12
CP 72-370	1	1	1	<1	1
CP 74-383	<1	<1	<1	0	<1
CP 79-318	0	<1	<1	0	<1
LCP 82-89	<1	2	2	3	2
LHo 83-153	0	<1	<1	<1	<1
LCP 85-384	84	81	74	75	79
HoCP 85-845	4	4	6	5	5
HoCP 91-555	2	1	<1	<1	1
Others	<1	<1	<1	1	<1

¹Based on 2001 variety survey information from County Agents.

Table 5. Estimated River-Bayou Lafourche Region sugarcane acreage percentage by variety and crop year, 2001¹.

Variety	Plant-Cane	First-Stubble	Second-Stubble	Third-Stubble And Older	Total
CP 65-357	<1	1	1	1	1
CP 70-321	2	3	6	8	4
CP 72-370	<1	1	2	1	1
CP 74-383	0	0	0	0	0
CP 79-318	0	<1	<1	0	<1
LCP 82-89	<1	1	2	1	1
LHo 83-153	1	2	3	4	2
LCP 85-384	85	76	69	69	75
HoCP 85-845	8	13	15	15	12
HoCP 91-555	3	1	<1	<1	1
Others	1	<1	1	1	1

¹Based on 2001 variety survey information from County Agents.

Table 6. Estimated Northern Region sugarcane acreage percentage by variety and crop year, 2001¹.

Variety	Plant-Cane	First-Stubble	Second-Stubble	Third-Stubble And Older	Total
CP 65-357	0	<1	1	6	1
CP 70-321	1	7	17	15	10
CP 72-370	0	<1	<1	0	<1
CP 74-383	<1	<1	1	<1	<1
CP 79-318	0	<1	1	0	<1
LCP 82-89	1	1	1	0	1
LHo 83-153	<1	<1	1	1	<1
LCP 85-384	87	85	71	72	79
HoCP 85-845	2	4	6	6	5
HoCP 91-555	9	1	<1	0	2
Others	<1	1	1	1	1

¹Based on 2001 variety survey information from County Agents.

Table 7. Louisiana sugarcane variety trends 1997-2001¹.

Variety	% of State total acreage by year					1 yr. Change
	1997	1998	1999	2000	2001	
CP 65-357	6	3	1	1	1	0
CP 70-321	35	29	20	13	8	-5
CP 72-370	7	5	3	2	1	-1
CP 74-383	2	1	<1	<1	<1	0
CP 79-318	3	2	1	<1	<1	0
LCP 82-89	10	7	5	2	1	-1
LHo 83-153	4	3	3	2	1	-1
LCP 85-384	29	43	58	71	78	+7
HoCP 85-845	4	6	8	8	7	-1
HoCP 91-555	<1	<1	<1	<1	1	1
Others	<1	1	<1	<1	1	1

¹Based on annual variety survey reports from County Agents in sugarcane-producing parishes, 1997-2001.

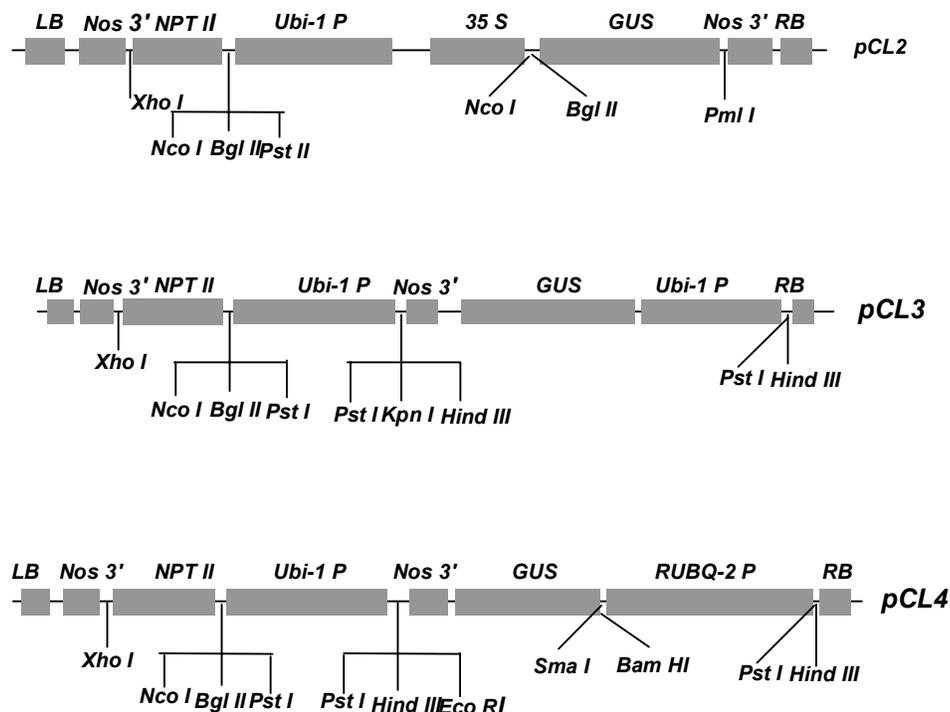
DEVELOPMENT OF DNA TRANSFORMATION TECHNOLOGY FOR LOUISIANA SUGARCANE

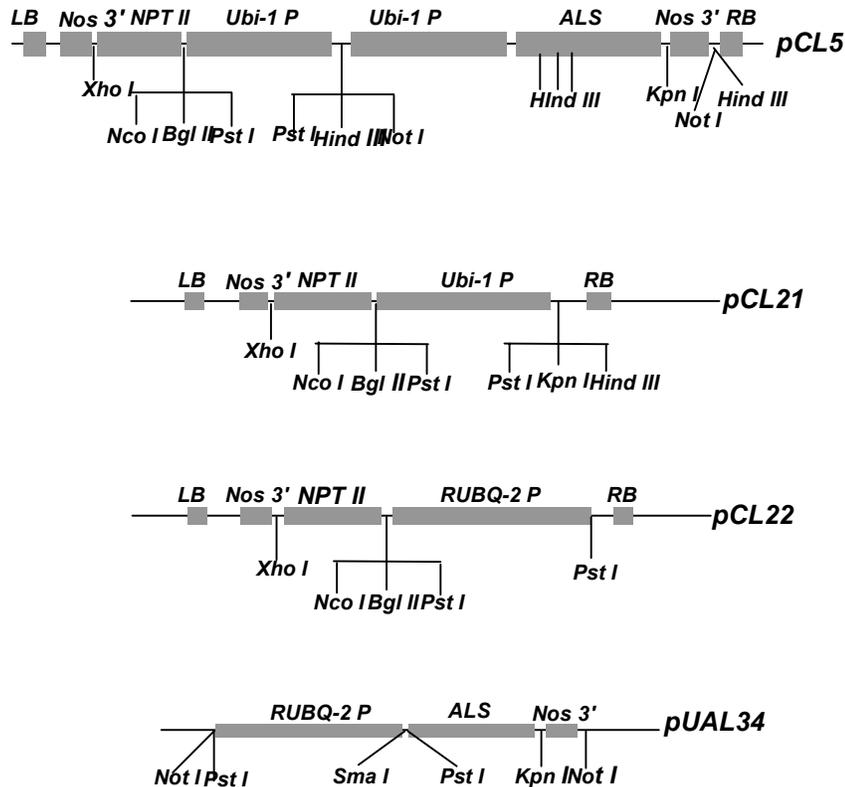
D. Liu, J. Oard, and K. A. Gravois*

Agronomy Department and *Sugar Research Station

Construction of DNA transformation vectors

Discovery and evaluation of new DNA regulatory elements and efficient selection agents are urgently needed for effective gene transfer technology in Louisiana sugarcane. Our previous research in 2000 showed that various selection agents such as hygromycin were not suitable for Louisiana sugarcane due to variable responses in different callus types, ages and physiological status. However, the NPT II gene which confers resistance to the compound kanamycin was shown to be an effective agent for selection of transformed cells. Moreover, we found that the 35S promoter that drives expression in various DNA vectors such as pCAMIA2301 functioned so poorly that gene expression was not detected. In contrast, we found that the rice and maize ubiquitin promoters could serve as strong, constitutive regulatory elements that drive strong gene expression in Louisiana sugarcane. Based on these results, we recently constructed seven new DNA vectors containing the NPT II, GUS, and ALS genes under control of the ubiquitin promoters. The following vectors have been constructed for the sugarcane transformation. Schematic representation of the vectors as restriction maps is shown below:





The plasmids pCL3 and pCL4 were used in the transformation of sugarcane via particle bombardment and *Agrobacterium*-mediated methods, and were shown to function at high levels (Liu and Oard, unpublished results). In related work these two plasmids showed high expression levels in rice shoot apices which demonstrates the utility of these vectors in different plant tissue and organs. Plasmids pCL21 and pCL22 can be used in the combination with pUAUA2 (Ubi-1 – ALS), constructed by S. Oard, or with pUAL34 for co-transformation studies. Plasmid pCL5 can be used to transfer ALS herbicide resistant gene into sugarcane by indirect selection.

Transient gene expression via *Agrobacterium* and particle bombardment methods

The plasmids pCL2, pCL3 and pCL4 were introduced into *Agrobacterium* strain LBA4404 and AGL1 by electroporation. The resulting strains were used to infect calli of sugarcane variety LCP-384 and GUS gene expression was determined by histochemical assays. The results showed that pCL4 with the rice ubiquitin promoter produced the highest GUS expression, levels while pCL2 containing the 35S promoter failed to give visible blue GUS transformed cells. Use of the *Agrobacterium* strain LBA4404 produced higher level of GUS expression than AGL1, and the *vir* gene inducer acetosyringone was indispensable for gene expression in the AGL1 strain.

Gene transformation via particle bombardment

Two target tissues, leaf segment and callus were used in the particle bombardment transformation studies. Leaf segments bombarded with plasmids pCL2, pCL3 and pCL4 showed

GUS gene expression, but the intensity and size of GUS blue spots varied greatly. The vector pCL4 produced the highest GUS blue spots, which was 27.8 times and 1.8 times higher than pCL2 and pCL3, respectively, by histochemical assays, and 29.1 times and 1.6 times than pCL2 and pCL3, respectively, by fluorescent assays.

Calli were bombarded separately with plasmids pCL2, pCL3 and pCL4. GUS gene expression was observed in the calli bombarded with all plasmids, but the differences among three plasmids were quite different. Vector pCL4 produced the best results with dark blue spots and sectors, which was 30 times and 1.5 times higher than pCL2 and pCL3, respectively, by histochemical assays, and 27 times and 1.4 times higher than pCL2 and pCL3, respectively, by fluorescent assays. These results showed that RUBQ2 and Ubi-1 promoters facilitated high gene expression levels in leaf and callus of Louisiana sugarcane.

Stable plant transformation and field test of transgenic sugarcane

Calli bombarded with pCL2, pCL3 and pCL4 were placed under selection using the antibiotic geneticin. Resistant calli were obtained in three separate experiments with particle bombardment after four rounds of selection. The resultant calli from pCL3 and pCL4 showed strong GUS reaction by histochemical assays and fluorescent assays. The GUS reaction was also observed in the shoot and leaf segments of transformed plants. These results showed that NPT II gene under the control of ubi-1 promoter was a reliable selectable marker, and successful transformation procedures for sugarcane have been developed.

PCR assays were used to test the presence of the NPT II gene in the transgenic plants. Results showed that NPT II gene was integrated in the transgenic plants. About 150 plants were generated from the resistant calli bombarded with pCL3, and 66 of them were tested for the presence of the NPT II protein using an ELISA assays. A total of 60 plants were positive for the NPT II protein, indicating that the NPT II gene was expressed in the transgenic plants and foreign genes can be efficiently expressed in variety LCP85-384. A total of 93 individual transformed plants derived from LCP85-384 were transplanted to the St. Gabriel Sugar Research Station on October 8, 2001. This material will be evaluated in 2002 for expression of GUS and NPTII genes and phenotypic variation among the different transformed lines.

Transformation for herbicide resistance

The plasmid pUAUA2 containing Ubi-1-ALS cassette and plasmid pCL4 containing the Ubi-1-NPT II cassette were used to co-bombard the calli, and selected under the antibiotics geneticin. Resistant calli were obtained after four rounds of selection, and transferred onto 2, 4-D free medium for regeneration. About 60 shoots were regenerated from resistant calli. Shoots from this material have been transplanted to green house for further analysis. Another co-transformation experiment was carried out using plasmid pCL21 containing Ubi-1- NPT II and plasmid containing RUBQ2-ALS cassette. Resistant calli were obtained from bombarded calli after selection, and transferred onto 2,4-D free medium for regeneration. Transgenic plants have been produced and are currently growing in the greenhouse. Transformation using the plasmid pCL5 was carried out, and selection for resistant calli is under way.