

ECONOMICALLY OPTIMAL CROP CYCLE LENGTH FOR MAJOR SUGARCANE VARIETIES IN LOUISIANA

Michael E. Salassi and Janis Breaux

Department of Agricultural Economics and Agribusiness
LSU Agricultural Center, Baton Rouge, LA 70803

ABSTRACT

The widespread adoption of the high-yielding variety LCP85-384 has resulted in two significant changes in the production sector of the Louisiana sugarcane industry. Plant characteristics of this variety make it very suitable for combine harvesting and have helped promote the conversion from wholestalk harvesting to combine harvesting in the state. Secondly, the variety is also an excellent stubbling variety, resulting in the expansion of standard sugarcane crop cycles beyond harvest of second stubble. Outfield trial yield data over the 1996-2000 period for major sugarcane varieties produced in Louisiana were used to determine the optimal crop cycle length which would maximize the net present value of producer returns. Cane yield and sugar per ton data for plantcane through third stubble were used to estimate the annualized net return of crop cycles through harvest of second and third stubble and to determine the breakeven level of fourth stubble yields which would justify production and harvest. Analysis of yield and net return data for the varieties CP 70-321, LCP 85-384, and HoCP 85-845 indicated that minimum yield levels necessary to keep older stubble in production for harvest depend directly upon the yields of the prior crop cycle phases and differ significantly across varieties.

INTRODUCTION

The production sector of the Louisiana sugarcane industry has undergone tremendous change over the past few years. Many sugarcane producers have switched from the use of wholestalk harvesters to combine harvesters. The performance rate difference between these two harvesters, coupled with the relatively more perishable billeted sugarcane, has caused producers and mills to look more closely at the timing and scheduling of sugarcane harvesting, transport, and milling operations. The release of the variety LCP 85-384 in 1993 has resulted in substantial changes in the sugarcane varieties grown in Louisiana. This variety is a high yielding variety with excellent stubbling ability (Legendre, 2000). In 1995, the leading sugarcane variety grown in Louisiana was CP 70-321, accounting for 49 percent of total acreage (Gravois, 1999). Other leading varieties produced included CP 65-357 and LCP 82-89, representing 15 percent and 13 percent of total state acreage, respectively. Acreage of LCP 85-384 only accounted for 3 percent of total sugarcane acreage in 1995. By 2000, acreage of LCP 85-384 had increased to 71 percent of total state sugarcane acreage. CP 70-321 and HoCP 85-845 were the second and third leading varieties produced in 2000 with only 14 percent and 8 percent of total acreage, respectively. Partly due to the widespread adoption of LCP 85-384 as well as the expansion of sugarcane into new production areas, total sugarcane acreage in Louisiana has increased from 370,000 acres in 1996 to 490,000 acres in 2000 (USDA, 2001). Total sugar production over the four-year period increased by 57 percent to 1.65 million tons of sugar, raw value.

The widespread adoption of the variety LCP 85-384 has caused producers to reevaluate the number of stubble crops to keep in production before plowing out and replanting. Traditionally, most sugarcane producers in Louisiana would harvest a plantcane crop and two stubble crops and then plow out the stubble after harvest of the second stubble crop. As a result of the excellent stubbling ability of LCP 85-384, producers are now considering such production decisions as how long should stubble crops be kept in production before plowing out or whether a stubble crop should be kept in production if a net profit could be made from its harvest. Although these questions are currently related to the production of LCP 85-384 in Louisiana, this basic production decision is relevant to the production of any sugarcane variety in any region or location.

Crane et al. (1980, 1982) developed a conceptual model of the stubble replacement decision for sugarcane production in Florida. Yield prediction equations (Alvarez et al., 1982) were estimated and integrated into a decision model of the stubble replacement problem for sugarcane varieties grown in Florida at that time. A more recent study in Louisiana used net present value methods to estimate the economic returns from the production of sugarcane varieties over an entire crop cycle (Salassi and Milligan, 1997). This study utilized data from advanced variety trials conducted at ten locations across Louisiana from 1990 through 1994.

The basic purpose of this article is to outline a methodology which can be used to determine the optimal number of sugarcane stubble crops to keep in production with the goal of maximizing producer net returns. Time value of money concepts are presented for purposes of evaluating the total cash flow of a sugarcane crop cycle over a multiyear period. Plantcane and stubble crop yields from outfield tests are then used to determine the optimal number of stubble crops for three major sugarcane varieties currently produced in Louisiana.

MATERIALS AND METHODS

Economic evaluation of sugarcane crop cycle length is generally concerned with determining the optimal length of a crop cycle which would maximize economic returns. More specifically, it involves the determination of when to plow out the existing stubble crop and replant to start a new crop cycle. The objective is to determine the optimal number of sugarcane stubble crops to harvest which would maximize average net returns to the producer over the entire crop cycle. Therefore, planting costs, cultivation and harvest costs, as well as yields and raw sugar prices, must be considered over the entire crop cycle. In order to correctly evaluate stubble decisions, the total cash flow from a sugarcane crop cycle, along with the appropriate adjustments for the time value of money, must be considered.

The cash flow stream from a sugarcane crop cycle can be depicted in the following manner:

<u>Time period</u>	<u>Item</u>	<u>Cashflow</u>
0	Planting costs	PC
1	Plantcane net returns	R1
2	First stubble net returns	R2
3	Second stubble net returns	R3
4	Third stubble net returns	R4

data for plantcane through third stubble crops were obtained from outfield tests conducted by the LSU Agricultural Center, the USDA Sugarcane Research Unit, and the American Sugar Cane League over the 1996-2000 period. Sugar per acre, cane yield in tons per acre, and sugar per ton values for the varieties CP 70-321, LCP 85-384, and HoCP 85-845 are shown in Table 1. Net returns per acre to the producer were estimated for a raw sugar price of 19 cents per pound and with a 30 pound per ton reduction in sugar per ton to reflect a 10 percent trash content in commercially recoverable sugar (CRS). Estimated production costs for various phases of the sugarcane production cycle in Louisiana were taken from published 2001 estimates (Breux and Salassi, 2001). Present value of net returns were calculated using a five percent discount rate. Total planting costs per acre of production cane is shown in Table 2 and includes all costs associated with fallow and seedbed preparation, purchase and expansion of seedcane, as well as the final mechanical planting of production cane.

RESULTS AND DISCUSSION

Total NPV and ANPV estimates of net returns were estimated for the varieties CP 70-321, LCP 85-384, and HoCP 85-845 for crop cycles extending through harvest of second and third stubble (Tables 3-5). Planting cost and production cost estimates for 2001 were used in the analysis. Based on the sugar yields used in this analysis, producer net returns would be maximized in the production of all three varieties by extending the crop cycle through harvest of at least third stubble.

Sugar per acre yields for CP 70-321, adjusted for average trash content, ranged from 7,020 pounds per acre for plantcane to 5,663 pounds per acre for third stubble (Table 3). Harvest through second stubble yielded a NPV of \$39 per acre and a ANPV of \$14 per acre. Estimated net returns per acre from a third stubble crop were \$96 per acre, which is higher than the ANPV through second stubble. Therefore, the average net returns over the crop cycle could be increased by extending the crop cycle through harvest of a third stubble crop. After factoring in third stubble net returns, the NPV of the crop cycle increased to \$118 per acre, or \$33 per acre per year.

Higher sugar per acre yields for LCP 85-384 resulted in higher estimates of net returns per acre compared to other varieties. With plantcane, first stubble, and second stubble sugar per acre yields above 7,400 pounds, the NPV of net returns of a crop cycle through harvest of second stubble was estimated to be \$379 per acre, or an average of \$139 per acre per year of harvest (Table 4). Third stubble yield of 6,973 pounds of sugar per acre resulted in producer net returns of \$221 per acre, higher than the ANPV through second stubble. Extension of the crop cycle through a third stubble harvest increased NPV of net returns to \$562 per acre, or \$158 per acre on an annual basis.

The NPV of crop cycle net returns for HoCP 85-845 were estimated to be \$127 per acre through harvest of second stubble and \$336 per acre through harvest of third stubble (Table 5). Commercially recoverable sugar per acre yields declined to 6,622 pounds for second stubble but increased to 7,314 pounds for third stubble. As a result, extension of the crop cycle through harvest of a third stubble crop increased annual net returns by \$48 per acre.

Although no yield data were available for fourth stubble yields, breakeven sugar yields required to

economically justify harvest of a fourth stubble crop were estimated for each of the three varieties at two different raw sugar price levels (Table 6). In order to maximize net returns over the crop cycle, a fourth stubble crop should be kept in production for harvest only if the projected net returns per acre equal or exceed the ANPV through third stubble. Average CRS values for each variety were used to determine breakeven sugar per acre and tonnage per acre values for a fourth stubble crop. At a raw sugar price of 19 cents per pound, breakeven fourth stubble sugar yields were estimated to be 5,010 pounds per acre for CP 70-321, 6,314 pounds per acre for LCP 85-384, and 5,651 pounds per acre for HoCP 85-845. An increase in projected raw sugar price to 21 cents per pound lowered the required breakeven sugar per acre yields by approximately 500 pounds.

CONCLUSIONS

In order to maximize economic net returns from the production of sugarcane, the optimal length of a crop cycle must be determined. This article presented a methodology for determining the optimal crop cycle length for sugarcane grown in any location. Outfield yield data through third stubble were used to determine optimal crop cycle length for three major varieties of sugarcane grown in Louisiana. Breakeven yields required to economically justify harvest of a fourth stubble crop were also estimated. Although sugarcane yield data through harvest of third stubble used in this study were the most comprehensive data available for the varieties studied, the time period represented by these data is relatively short (1996-2000). This may be a limitation to the results presented here and suggests that this area needs additional research as more time series data becomes available.

Three general conclusions can be drawn from this analysis. First, the economically optimal sugarcane crop cycle length is one which maximizes average net returns per acre over the entire crop cycle. Net returns over a multiyear crop cycle should be adjusted for the time value of money, thereby annualizing the total NPV of returns over the years of harvest. A decision rule which can be used to evaluate older stubble would state that a stubble crop should be kept in production for harvest only if the net returns from that crop would increase the average net returns over the crop cycle. Positive net returns from harvest of older stubble is no guarantee that average returns are being maximized. Secondly, economic evaluation of keeping older stubble in production is variety- and field-specific. Varieties with different yields and production costs will have different breakeven yields. Finally, when considering whether to keep current fields of older stubble in production, include the impact of varying sugar prices and yields. Higher (lower) projected stubble crop yields decrease (increase) required breakeven sugar prices. Lower (higher) projected sugar prices increase (decrease) required breakeven stubble crop yields.

REFERENCES

1. Alvarez, J., D. R. Crane, T. H. Spreen, and G. Kidder. 1982. A yield prediction model for Florida sugarcane. *Agricultural Systems*. 9:161-179.
2. Boehlje, Michael D., and Vernon R. Eidman. 1984. *Farm Management* (chapter 8). John Wiley and Sons, New York.

3. Breaux, Janis, and Michael E. Salassi. 2001. Projected costs and returns - sugarcane, Louisiana, 2001. LSU Agricultural Center, Department of Agricultural Economics and Agribusiness, A.E.A. Information Series No. 192.
4. Crane, Donald R., and Thomas H. Spreen. 1980. A model of the stubble replacement decision for Florida sugarcane growers. *Southern Journal of Agricultural Economics*. 12:55-64.
5. Crane, D.R., T.H. Spreen, J. Alvarez, and G. Kidder. 1982. An analysis of the stubble replacement decision for Florida sugarcane growers. *University of Florida Agricultural Experiment Station Bulletin No. 882*.
6. Gravois, Kenneth. 1999. The 1999 Louisiana sugarcane variety survey. Sugarcane research annual progress report, 1999. Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, Baton Rouge, LA., pp. 91-96.
7. Kay, Ronald D., and William M. Edwards. 1999. *Farm Management*, 4th edition. WCB/McGraw-Hill, New York.
8. Legendre, Benjamin L. 2000. Sugarcane planting recommendations and suggestions. Louisiana Cooperative Extension Service, Louisiana State University Agricultural Center, Baton Rouge, LA.
9. Salassi, M. E., and S. B. Milligan. 1997. Economic analysis of sugarcane variety selection, crop yield patterns, and ratoon crop plow out decisions. *Journal of Production Agriculture*. 10:539-545.
10. United States Department of Agriculture. 2001. *Sugar and Sweetener Situation and Outlook Report*. Economic Research Service, SSS-230, January.

Table 1. Mean sugarcane yields for three commercial varieties across locations, 1996-2000.

Variety	Sugar per acre (<i>lbs./acre</i>)	Cane yield (<i>tons/acre</i>)	Sugar per ton (<i>lbs./ton</i>)
<u>Plantcane, 1996-2000:</u>			
CP 70-321	7899	30.0	264
LCP 85-384	8919	33.1	270
HoCP 85-845	7898	32.3	245
<u>First stubble, 1996-2000:</u>			
CP 70-321	7771	29.0	269
LCP 85-384	9414	34.5	273
HoCP 85-845	8115	31.5	257
<u>Second stubble, 1996-2000:</u>			
CP 70-321	6452	25.3	256
LCP 85-384	8429	32.0	264
HoCP 85-845	7574	30.1	250
<u>Third stubble, 1997-2000:</u>			
CP 70-321	6354	24.2	264
LCP 85-384	7847	29.3	268
HoCP 85-845	8215	31.8	260

Table 2. Total sugarcane planting costs per acre.

<u>Cost item:</u>	Cost per acre (<i>dollars per acre</i>)	Percent of acre (%)	Total cost per acre (<i>dollars per acre</i>)
Fallow / seedbed preparation	231.61	1.00	231.61
Cultured seedcane	499.75	0.03	17.77
Hand planting seedcane	250.78	0.03	8.92
Propagated seedcane	73.91	0.19	15.02
Mechanical planting seedcane	162.01	0.97	<u>156.78</u>
Total planting cost			<u>430.11</u>

Planting cost allocation based on an initial planting of 0.032 acres of cultured seedcane followed by two seedcane expansions using a 5:1 planting ratio.

Table 3. Annualized crop cycle net returns for CP 70-321.

Crop cycle phase	Recoverable sugar yield	Harvest through second stubble	Harvest through third stubble
	<i>(lbs. per acre)</i>	<i>(dollars per acre)</i>	
Fallow / Plant ^a	--	(\$430)	(\$430)
Plantcane ^b	7020	\$181	\$181
First stubble ^b	6931	\$231	\$231
Second stubble ^b	5718	\$101	\$101
Third stubble ^b	5663	--	\$96
NPV of total returns ^c	--	\$39	\$118
ANPV of total returns ^d	--	\$14	\$33

^a Nominal fallow, seedbed preparation and planting cost.

^b Nominal net returns per acre above cultivation and harvest costs.

^c Net present value of total net returns over crop cycle.

^d Annualized net present value of net returns.

Table 4. Annualized crop cycle net returns for LCP 85-384.

Crop cycle phase	Recoverable sugar yield	Harvest through second stubble	Harvest through third stubble
	<i>(lbs. per acre)</i>	<i>(dollars per acre)</i>	
Fallow / Plant ^a	--	(\$430)	(\$430)
Plantcane ^b	7944	\$252	\$252
First stubble ^b	8384	\$370	\$370
Second stubble ^b	7488	\$271	\$271
Third stubble ^b	6973	--	\$221
NPV of total returns ^c	--	\$379	\$562
ANPV of total returns ^d	--	\$139	\$158

^a Nominal fallow, seedbed preparation and planting cost.

^b Nominal net returns per acre above cultivation and harvest costs.

^c Net present value of total net returns over crop cycle.

^d Annualized net present value of net returns.

Table 5. Annualized crop cycle net returns for HoCP 85-845.

Crop cycle phase	Recoverable sugar yield	Harvest through second stubble	Harvest through third stubble
	<i>(lbs. per acre)</i>	<i>(dollars per acre)</i>	
Fallow / Plant ^a	--	(\$430)	(\$430)
Plantcane ^b	6945	\$175	\$175
First stubble ^b	7151	\$252	\$252
Second stubble ^b	6622	\$188	\$188
Third stubble ^b	7314	--	\$254
NPV of total returns ^c	--	\$127	\$336
ANPV of total returns ^d	--	\$47	\$95

^a Nominal fallow, seedbed preparation and planting cost.

^b Nominal net returns per acre above cultivation and harvest costs.

^c Net present value of total net returns over crop cycle.

^d Annualized net present value of net returns.

Table 6. Breakeven fourth stubble yields for three major varieties.

Fourth stubble yield	CP 70-321	LCP 85-384	HoCP 85-845
ANPV ^a (third stubble)	\$33	\$158	\$95
Breakeven yield:			
Sugar per acre (19¢)	5010	6314	5651
Avg. CRS ^b	233	239	223
Est. tons per acre	21.5	26.4	25.3
Sugar per acre (21¢)	4546	5731	5129
Avg. CRS ^b	233	239	223

Est. tons per acre	19.5	24.0	23.0
--------------------	------	------	------

^a Annualized net present value of net returns.

^b Average commercially recoverable sugar in pounds per ton of cane.