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Economically Optimal Crop Cycle Length for Major Sugarcane Varieties in Louisiana

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Introduction

The recent, widespread adoption of the variety LCP 85-384 has caused sugarcane producers in Louisiana 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 plant-cane crop and two stubble crops. After harvest of the second-stubble crop, the sugarcane stubble would be plowed out and the field would be fallowed before starting a new crop cycle with planting of seedcane in late summer or early fall. As a result of the excellent stubbling ability of LCP 85-384, producers are now considering such production decisions as how long stubble crops should 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 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.

This report outlines a procedure that 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. Plant cane and stubble crop yields from outfield tests are then used to determine the optimal number of stubble crops for two major sugarcane varieties produced in Louisiana.

Crop Cycle Costs and Returns

Economic evaluation of sugarcane crop cycle length is generally concerned with determining the optimal length of a crop cycle that 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 that 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. To evaluate stubble decisions correctly, producers must consider the total cash flow from a sugarcane crop cycle, along with the appropriate adjustments for the time value of money.

The cash flow stream from a sugarcane crop cycle can be depicted as:

Year	Item	Cashflow
0	Planting costs	PC
1	Plant-cane net returns	R1
2	First-stubble net returns	R2
3	Second-stubble net returns	R3
4	Third-stubble net returns	R4
n	n-1 stubble net returns	Rn

At the beginning of the crop cycle, planting costs per acre (PC) are incurred with harvest beginning the following year. Net returns per acre to the producer are then received for the harvest of plant cane (R1) through the final stubble crop harvest (Rn). The decision the producer faces is when to end the crop cycle with the objective of maximizing net returns. This problem is a farm management example of investment analysis, in which a sum of money is invested at a point in time and declining annual net re-

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turns are received in the following years. The objective is to determine the length of the investment (in years) that will maximize net returns.

Because the cash flow from a sugarcane crop cycle extends over several years, any analysis of that cash flow should incorporate the time value of money. The net present value of a sugarcane crop cycle income stream can be represented as:

$$NPV = \frac{R1}{(1+r)^1} + \frac{R2}{(1+r)^2} + \frac{R3}{(1+r)^3} + \frac{R4}{(1+r)^4} + \ldots \frac{Rn}{(1+r)^n} - PC$$

or

$$NPV = \sum_{t=1}^{n} (1+r)^{-t} R_t - PC$$

where NPV is the net present value per acre of the income stream, R1 is the net returns per acre from plant cane, R2 is the net returns per acre from first stubble, R3 is the net returns per acre from second stubble, Rn is the net returns per acre from the last stubble crop harvested, PC is the initial planting cost per acre and r is a discount rate. The net present value of income from a crop cycle can be interpreted as the total net income from harvest of plant cane and stubble crops less planting costs and all cultivation and harvest costs incurred adjusted for the time value of money.

To compare the relative profitability of different crop cycles and to determine breakeven yields and sugar prices required to keep a stubble crop in production for harvest, the net present value of the income stream must be annualized or converted to an average net return per year. This annualized value can be obtained by multiplying the net present value estimate by a capital recovery factor:

$$ANPV = NPV \times [\, r / 1 - (1 + r)^{-n} \,]$$

The annualized net present value (ANPV) of a crop cycle income stream can be interpreted as the average net return per acre per year over a particular crop cycle adjusted for the time value of money. This is the net income estimate that should be maximized to maximize returns from a crop cycle. The decision rule is that a sugarcane stubble crop should be kept in production for harvest if the net returns from the harvest of that crop will increase the annualized net present value of the crop cycle income stream. If harvest of the stubble crop will result in a decrease in the average annualized net income, it should be plowed out even if a profit could be made from its harvest. Positive net returns from older stubble crops are no guarantee that average net returns are being maximized.

To evaluate optimal sugarcane crop cycle lengths for major varieties produced in Louisiana, yield data for plant cane through third-stubble crops were obtained from outfield tests over the 1996-2000 period conducted by the LSU Agricultural Center, the USDA Sugarcane Research Unit and the American Sugar Cane League. Sugar per acre, cane yield in tons per acre and sugar per ton values for two major varieties, CP 70-321 and LCP 85-384, were used in this analysis. 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. Total planting costs per acre of production cane were approximately $430 per acre and include all costs associated with fallow and seedbed preparation, purchased and expansion of seedcane, as well as the final mechanical planting of production cane.

Results and Discussion

Estimated recoverable sugar per acre, as well as the costs and returns components of a crop cycle total cash flow, are presented in Table 1 for the varieties CP 70-321 and LCP 85-384 for crop cycles extending through harvest of second and third stubble. Planting cost and production cost estimates for 2001 were used in this analysis. Based on the sugar yields used in this analysis, producer net returns would be maximized in the production of both varieties by extending the crop cycle through harvest of at least third stubble.

Sugar per acre yields for CP 70-321, adjusted for an average 10% trash content, ranged from 7,020 pounds per acre for plant cane to 5,663 pounds per acre for third stubble. Harvest through second stubble yielded total nominal net returns above all planting, cultivation and harvest costs of $83 per acre or an average of $28 per acre per year of harvest. After adjustment for the time value of money, the net present value (NPV) of total crop cycle net returns was an estimated $39 per acre with an annualized value (ANPV) of $14 per acre. Estimated net returns per acre from a third-stubble crop of CP 70-321, based on a sugar yield of 5,663 pounds per acre, was $96 per acre (with raw sugar valued at 19 cents per pound). Since the estimated net returns per acre from a third-stubble crop were higher than the annualized net return value for a crop cycle through

Table 1. Estimated crop cycle net returns for CP 70-321 and LCP 85-384.

Crop cycle phase	CP 70-32 Sugar yield	CP 70-32 Harvest through second stubble	CP 70-32 Harvest through third stubble	LCP 85-384 Sugar yield	LCP 85-384 Harvest through second stubble	LCP 85-384 Harvest through third stubble
	(lbs./acre)	*(dollars/acre)*		*(lbs./acre)*	*(dollars/acre)*	
Fallow / plant	—	($430)	($430)	—	($430)	($430)
Plant cane	7020	$181	$181	7944	$252	$252
First stubble	6931	$231	$231	8384	$370	$370
Second stubble	5718	$101	$101	7488	$271	$271
Third stubble	5663	—	$96	6973	—	$221
Total net returns	—	$83	$179	—	$463	$684
Average net returns per year	—	$28	$45	—	$154	$171
NPV of total returns	—	$39	$118	—	$379	$562
ANPV of total returns	—	$14	$33	—	$139	$158

harvest of second stubble, average net returns per acre over the crop cycle could be increased by keeping the third-stubble crop in production for harvest. Therefore, for this particular set of sugar yields, average net returns over the crop cycle could be maximized by extending the crop cycle through harvest of a third-stubble crop. After factoring in third-stubble net returns, the total nominal net returns over the crop cycle increased to $179 per acre for a four-year harvest, or $45 per acre per year. The NPV of the crop cycle net returns increased to $118 per acre, or an annualized value of $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 CP 70-321. With plant cane, 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 an estimated $379 per acre, or an average of $139 per acre per year of harvest. 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 annually.

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 these varieties at two different raw sugar price levels (Table 2). 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 received from the harvest of the fourth-stubble crop equal or exceed the ANPV of the crop cycle 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 and 6,314 pounds per acre for LCP 85-384. An increase in projected raw sugar price to 21 cents per pound lowered the required breakeven sugar per acre yields by about 500 pounds.

To maximize economic net returns from the production of sugarcane, the optimal length of a crop cycle must

Table 2. Breakeven fourth-stubble yields for CP 70-321 and LCP 85-384.

	CP 70-321	LCP 85-384
ANPV (third stubble)	$33	$158
Breakeven fourth-stubble yield:		
Sugar per acre (19¢)	5010	6314
Avg. CRS	233	239
Est. tons per acre	21.5	26.4
Sugar per acre (21¢)	4546	5731
Avg. CRS	233	239
Est. tons per acre	19.5	24.0

be determined. This report 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 two major varieties of sugarcane grown in Louisiana. Breakeven yields required to justify harvest of a fourth-stubble crop also were estimated.

Three general conclusions can be drawn from this analysis. First, the economically optimal sugarcane crop cycle length is one that 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 net present value of returns over the years of harvest. A decision rule that 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 will increase the average net returns over the crop cycle. Positive net returns from harvest of older stubble are no guarantee that average returns are being maximized. Second, 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.

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