

## **ESTIMATED COST DIFFERENCES BETWEEN WHOLE-STALK AND BILLET SUGARCANE PLANTING METHODS IN LOUISIANA**

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### **ABSTRACT**

Sugarcane planting costs were estimated for four types of planting systems: hand planting, whole-stalk machine planting, and one-row and three-row billet planting. Planting ratios and labor requirements were determined from data collected from growers using the various planting methods. Whole-stalk planting ratios were 7.5/1 for hand planting and 5.5/1 for machine planting, while planting ratios for billet planters were 3.0/1. Total planting costs per acre of plant-cane planted were estimated at \$579 for whole-stalk hand planting, \$578 for whole-stalk machine planting, \$712 for one-row billet planting and \$673 for three-row billet planting. Calculations reveal that increasing the planting ratio for billet planters could significantly reduce planting costs. Opportunity costs of increased seed cane acreage were found to be a significant economic factor in the evaluation of billet planting.

### **INTRODUCTION**

In recent years, two developments have dramatically changed sugarcane production in Louisiana. The widespread adoption of the higher yielding cultivar LCP 85-384 as well as the rapid adoption of the billet (stalk section) combine sugarcane harvester significantly changed sugarcane production and harvest in Louisiana. These two developments are closely related, as the combine harvester is well suited to handle the higher field tonnage associated with the cultivar LCP 85-384. Total state acreage of LCP 85-384 increased from 43 percent of total state sugarcane acreage in 1998 to 88 percent in 2003 (Legendre and Gravois, 2004). Acreage of LCP 85-384 in 2004 approached 90 percent of total state sugarcane acreage. The adoption of the combine harvester has tracked very closely with the adoption of LCP 85-384.

With the switch to billet harvesting, there has been growing interest in the Louisiana sugar industry concerning the potential for billet planting of sugarcane. Some growers have purchased billet planters and are planting some or all of their crop from billet seed cane. Both on-station and on-farm research has been conducted over the past few years to determine the feasibility of planting billets in Louisiana (Hoy et al., 2002; Hoy et al., 2003, Hoy et al., 2004). Factors evaluated in these tests have included optimum billet length, date of planting, use of fungicides, as well as planting rates. In most experiments, the sugar per acre yield of whole-stalk planting has been higher during the plant-cane crop, but yield differences were no longer significant in the ratoon crops. Yields of whole-stalk and billet plantings have been comparable

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throughout the entire crop cycle. However, the results have suggested that, in general, the highest yields over time will be obtained with whole-stalk planting. Billet seed cane is more sensitive to planting problems, such as excessively wet or dry weather or seed cane damage, than whole-stalk seed cane.

Four different sugarcane planting methods are currently being utilized in Louisiana to varying degrees. These methods are: (1) whole-stalk hand plant, (2) one-row whole-stalk machine plant, (3) one-row billet plant and (4) three-row billet plant. These four planting methods refer to the type of planter and planting material used for the first and second seed cane expansions. The initial planting of tissue cultured seed cane is usually hand planted as whole stalks. Once harvested, this tissue cultured seed cane is typically expanded twice (harvested and replanted). The planting of the second seed cane expansion is plant-cane which would be sent to the mill for grinding. A common method of planting sugarcane seed cane expansions in Louisiana, currently, is machine planting of whole-stalk seed cane, one row at a time. Some growers are starting to use one-row billet planters to plant seed cane and a few three-row billet planters are in operation. Data collected over the past couple of years has shown that planting ratios (acres of sugarcane planted per acre of seed cane harvested) differ significantly from one planting method to another. Discussions with growers have indicated that the average planting ratio for hand planted whole-stalk sugarcane was about 7.5/1. The planting ratio for one-row machine planted whole-stalk sugarcane was about 5.5/1. Planting ratios for both the one-row and three-row billet planters were substantially less, at about 3.0/1.

Both field research and grower input has indicated that the planting ratio (acres of sugarcane planted per acre of seed cane harvested) is substantially different between whole-stalk and billet planting methods. Given the multi-year sugarcane seed cane expansion process utilized in Louisiana, questions have arisen regarding possible differences in the cost of planting billets versus planting whole-stalk seed cane. Information has been collected from growers using the billet planting method regarding the planting time, labor and seed cane requirements, as well as factors associated with using billet planters. This article presents some initial, preliminary estimates of the cost differences that may exist between planting whole-stalk seed cane versus planting billet seed cane for Louisiana. Cost estimates presented here are based on a specific set of field and planting operations. Actual planting costs on farms may be different from these estimates due to differences in specific field operations performed, as well as several other factors. The primary focus of this article is to show the relative level of planting costs for the various planting methods and to identify which factors have a significant effect on the level of these costs.

### **MATERIALS AND METHODS**

This article presents estimates of total sugarcane planting costs in Louisiana for the four existing planting methods: (1) hand plant, (2) one-row whole-stalk machine plant, (3) one-row billet machine plant, and (4) three-row billet machine plant. In order to estimate the total

investment in planting costs per acre of mill cane planted, budgets were developed to estimate the costs associated with each phase of the entire sugarcane planting operation. These budgets represent projected sugarcane production costs for the 2004 crop season (Breux and Salassi, 2004). A summary of these costs, both variable and fixed cost, are shown in Table 1. Variable, fixed, and total costs for nine categories of planting operations are listed, along with a brief description of what each cost estimate represents are presented.

**Table 1.** Estimated costs of sugarcane planting operations.

Planting operation	Variable cost per acre	Fixed cost per acre	Total cost per acre
	----- dollars per acre -----		
(1) Purchase tissue cultured seed cane	515.71	10.36	526.07
(2) Fallow and seedbed preparation	124.67	83.19	207.86
(3) Harvest whole-stalk seed cane	45.16	33.81	78.97
(4) Harvest billet seed cane (for one-row planter)	53.89	37.16	91.05
(5) Harvest billet seed cane (for three-row planter)	77.81	55.62	133.43
(6) Hand plant whole-stalk seed cane	208.28	68.59	276.87
(7) Machine plant whole-stalk seed cane (one-row)	186.09	52.86	238.95
(8) Machine plant billet seed cane (one-row)	158.84	52.86	211.70
(9) Machine plant billet seed cane (three-row)	121.42	47.03	168.45

The \$526.07 cost for purchased tissue cultured seed cane (1) represents the costs of purchasing tissue cultured seed cane and loading it onto a planting wagon. Fallow and seedbed preparation costs (2) of \$207.86 represents the costs associated with plowing out old stubble and preparing the seedbed for planting. Costs of harvesting whole-stalk seed cane (3), \$78.97 per acre, includes the cost of a whole-stalk harvester, as well as the cost of loading the whole-stalk seed cane into a wagon. Harvesting billet seed cane costs for a one-row billet planter (4) of \$91.05 per acre include the cost of a one-row combine harvester, as well as the cost of loading the billet seed cane into wagons. Harvesting billet seed cane costs for a three-row billet planter (5) of \$133.43 per acre include the cost of a one-row combine harvester, as well as the cost of additional wagons to move the harvested seed cane from the field to the planter. Hand planting whole-stalk seed cane costs (6) were estimated at \$276.87 per acre and include costs for opening rows, hand planting the seed cane with three walkers fixing rows, closing the rows and applying an at-planting application of fertilizer and herbicide. Machine planted whole-stalk costs (7), \$238.95 per acre, represent opening and closing rows, machine planting whole-stalk seed cane with two walkers, as well as starter fertilizer and at-planting herbicide applications. Planting costs for the one-row (8) and three-row (9) billet planters, \$211.70 and \$168.45 per acre, respectively, include costs for the same row opening and closing operations, as well as starter fertilizer and herbicide applications as listed above. The one-row billet planter utilizes one walker fixing rows, while the three-row billet planter requires no walkers but does utilize three billet wagons supplying the planter with seed cane in the field. All seed cane row fixing labor is charged at \$25 per person per acre.

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**RESULTS AND DISCUSSION**

The required quantity of seed cane differed substantially between whole-stalk and billet planting (Table 2). The hand plant and machine plant whole-stalk methods required 1.8 acres and 3.3 acres, respectively, of initial tissue cultured seed cane in order to yield 100 acres of plant-cane after two seed cane expansions. At the lower planting ratios, the one-row and three-row billet planters required 11.1 acres of tissue cultured seed cane to yield the same amount of plant-cane after two expansions.

**Table 2.** Acres of seed cane required to plant 100 acres of plant-cane.

Planting operation	Whole-stalk hand plant (7.5/1) <sup>1</sup>	Whole-stalk machine plant (5.5/1) <sup>1</sup>	Billet one-row planter (3.0/1) <sup>1</sup>	Billet three-row planter (3.0/1) <sup>1</sup>
	-----acres of seed cane planted-----			
Plant tissue cultured seed cane	1.8	3.3	11.1	11.1
Plant 1 <sup>st</sup> seed cane expansion	13.3	18.2	33.3	33.3
Plant 2 <sup>nd</sup> seed cane expansion	100.0	100.0	100.0	100.0

<sup>1</sup> Planting ratio (acres planted per acre of seed cane).

One of the proposed advantages of billet planting is the ability to plant more acres of sugarcane in a given time period with less labor, particularly when using the three-row billet planter. Information obtained from growers indicated that this proposition is, in fact, true. A three-row billet planter has the capability to plant significantly more acres of sugarcane in a day than the other planting methods. Acres planted per day were estimated to be roughly 8 acres per day for whole-stalk hand planting and 12 acres per day for whole-stalk machine planters and one-row billet planters (Table 3). A three-row billet planter has the capability to plant up to 40 acres per day. These figures were converted to hours per acre in order to estimate machine and labor requirements per acre planted. The resulting planting time requirements were 1.00 hours per acre for hand planted whole-stalk, 0.67 hours per acre for machine planted whole-stalk and one-row billet planters, and 0.20 hours per acre for three-row billet planters.

**Table 3.** Planting time requirements for alternative planting methods.

Planting time	Whole-stalk hand plant	Whole-stalk machine plant	Billet one-row planter	Billet three-row planter
Acres planted per day	8	12	12	40
Acres planted per hour	1.0	1.5	1.5	5.0
Hours per acre	1.00	0.67	0.67	0.20

Using the planting time and labor requirements, as well as the estimated planting operations costs, the total planting cost per acre of plant-cane planted for harvest of sugar was estimated for the four planting methods (Table 4). A planting ratio of 7.5/1 is assumed for hand planted whole-stalk seed cane and a planting ratio of 5.5/1 is assumed for the one-row whole-stalk machine planter. Total planting cost investment per acre of plant-cane was estimated at \$579 per acre for the hand planted whole-stalk seed cane. Total estimated planting costs per acre of plant-cane for the whole-stalk machine planter were very similar at \$578 per acre of plant-cane planted. Total variable costs per acre, primarily fuel, labor and repair costs, as well as seed cane purchase expense, were also similar, estimated to \$399 and \$405 per acre of plant-cane, respectively. Although the machine planting of whole-stalk seed cane is a less expensive operation than hand planting, these cost savings are offset by the additional expense of increased seed cane acreage required for a whole-stalk machine planter resulting from a slightly lower planting ratio. Cost estimates indicate that the cost of planting the second seed cane expansion on 100 acres of plant-cane using a whole-stalk machine planter is \$3,792 less expensive than hand planting. However, due to the lower planting ratio for the machine planter (5.5/1 compared to 7.5/1), costs associated with the purchase, planting and the first expansion of tissue cultured seed cane were estimated to be \$3,710 more expensive, thereby offsetting the cost savings from the use of the machine planter.

**Table 4.** Estimated planting costs for 100 acres of plant-cane, whole-stalk planting.

Planting cycle phase	Whole-stalk hand plant <sup>1</sup>		Whole-stalk machine plant <sup>2</sup>	
	Acres required	Total cost	Acres required	Total cost
	--acres--	-dollars-	--acres--	-dollars-
Tissue cultured seed cane	1.8	1,937	3.3	3,603
First seed cane expansion	13.3	7,516	18.2	9,560
Second seed cane expansion	100.0	48,473	100.0	44,681
Total cost to plant 100 acres		57,926		57,843
Total planting cost per acre		579		578
Variable planting cost per acre		399		405

<sup>1</sup> Whole-stalk planted seed cane planted by hand with a 7.5:1 planting ratio.

<sup>2</sup> Whole-stalk planted seed cane using a one-row whole stalk planter with a 5.5:1 planting ratio.

Planting ratios for both the one-row and three-row billet planter were assumed to be 3.0/1. As a result, a significantly higher quantity of seed cane acreage is required to plant the same amount of plant-cane acreage. Total planting costs for the one-row billet planter were estimated to be \$712 per acre of plant-cane planted, with total variable costs estimated to be \$496 per acre (Table 5). Cost estimates for the three-row billet planter were slightly less, due primarily to the lower cost of the planting operation itself using a three-row planter. These estimated costs for the billet planting methods are significantly higher than costs estimated for whole-stalk planting methods. The primary reason for these cost differences is the significantly lower planting ratio being observed with billet planters currently in use.

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Increases in the planting ratio of the billet planting system can make it more economically competitive with the predominant whole-stalk machine planting system. An increase in the planting ratio of the one-row billet planter, from 3.0/1 to 4.0/1, reduces total planting costs, per 100 acres of plant-cane, from \$712 to \$616 (Table 6). Total estimated planting costs for the three-row billet planting system declined from \$673 to \$575 per acre of plant-cane planted. At these planting ratios, costs for the billet planter can be reduced to levels similar to those of the whole-stalk planter. However, increased sensitivity of seed cane billets to planting conditions and the risk of stand problems have, up to this point, inhibited farmers from increasing planting ratios much above 3.0/1.

**Table 5.** Estimated planting costs for 100 acres of plant-cane, billet planting, 3:1 planting ratio.

Planting cycle phase	One-row billet plant <sup>1</sup>		Three-row billet plant <sup>2</sup>	
	Acres required	Total cost	Acres required	Total cost
	--acres--	-dollars-	--acres--	-dollars-
Tissue cultured seed cane	11.1	12,243	11.1	12,714
First seed cane expansion	33.3	17,020	33.3	16,991
Second seed cane expansion	100.0	41,956	100.0	37,631
Total cost to plant 100 acres		71,219		67,336
Total planting cost per acre		712		673
Variable planting cost per acre		496		457

<sup>1</sup> Billet planted seed cane using a one-row billet planter with a 3.0:1 planting ratio.

<sup>2</sup> Billet planted seed cane using a three-row billet planter with a 3.0:1 planting ratio.

**Table 6.** Estimated planting costs for 100 acres of plant-cane, billet planting, 4:1 planting ratio.

Planting cycle phase	One-row billet plant <sup>1</sup>		Three-row billet plant <sup>2</sup>	
	Acres required	Total cost	Acres required	Total cost
	--acres--	-dollars-	--acres--	-dollars-
Tissue cultured seed cane	6.3	6,887	6.3	7,151
First seed cane expansion	25.0	12,765	25.0	12,744
Second seed cane expansion	100.0	41,956	100.0	37,631
Total cost to plant 100 acres		61,608		57,526
Total planting cost per acre		616		575
Variable planting cost per acre		424		385

<sup>1</sup> Billet planted seed cane using a one-row billet planter with a 4.0:1 planting ratio.

<sup>2</sup> Billet planted seed cane using a three-row billet planter with a 4.0:1 planting ratio.

One indirect non-cash, yet very significant, cost associated with the use of billet planters is the opportunity cost related to the increased seed cane acreage required. For a given size farm, an increase in acreage devoted to seed cane production results in a corresponding decrease in sugarcane acreage devoted to sugar production. The reduction in acreage results in a reduction of income to the grower, landlord and the mill. This reduction in income is an opportunity cost associated with the use of billet planters. An example of this cost calculation is presented in Table 7. Based on the assumed planting ratios of whole-stalk and one-row billet planters, the use of a billet planting system to plant 100 acres of plant-cane would require 7.8 additional acres of tissue cultured seed cane and 15.1 additional acres of first expansion seed cane. The gross income which would have been generated from this 22.9 total acres, had it been harvested for sugar, would be \$32,060, based on a 7,000 lb yield and a raw sugar price of \$0.20. Over 100 acres of plant-cane this cost would be approximately \$321 per acre of plant-cane planted, representing an estimated income loss to the grower, landlord and mill. Although this is not an actual cash cost, it is an important economic cost which must be considered. An increase in the planting ratio for billet planters would significantly decrease this opportunity cost. At a planting ratio of 4.0/1, the use of the billet planting system to plant 100 acres of plant-cane would require 3.0 additional acres of tissue cultured seed cane and 6.8 additional acres of first expansion seed cane compared with the whole-stalk planter. The opportunity cost of income lost from this 6.8 acres additional seed cane acreage would decline to approximately \$137 per acre of plant-cane planted.

**Table 7.** Estimated opportunity cost of additional seed cane acreage required by billet planters.

Planting operation	Seed cane acres required <sup>1</sup>		Additional seed cane acres required
	Whole-stalk machine planter	One-row billet planter	
	--acres--	--acres--	
Plant tissue cultured seed cane	3.3	11.1	7.8
Plant first seed cane expansion	18.2	33.3	15.1
Plant second seed cane expansion	100.0	100.0	-
Total additional seed cane acres			22.9
Opportunity cost of additional seed cane acreage per acre of plant-cane planted <sup>2</sup>			\$321

<sup>1</sup> Seed cane acres required to plant 100 acres of plant-cane. Planting ratios: one-row machine whole stalk planter 5.5/1, one-row billet planter 3.0/1.

<sup>2</sup> Opportunity cost calculated as 22.9 acres x 7,000 lbs per acre x \$0.20 per lb / 100 acres.

Based upon the results from this initial cost study, a few conclusions can be drawn. First, billet planters do provide an opportunity to reduce planting time and labor requirements. However, these cost savings are small, relative to the total cost of planting, because they only affect the cost of the planting operation itself and have no impact on fallow and seed bed preparation costs. Secondly, although several factors impact the cost of billet planting relative to

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whole-stalk planting, the single most important factor affecting the cost of billet planting seems to be the planting ratio. A change in the planting ratio changes the acreage of seed cane required, thereby impacting all planting cost operations. And finally, planting ratios of at least 4.0/1 are necessary in order for the billet planting system to be comparable on a cost basis to the whole-stalk system.

A few final thoughts also should be mentioned here. First, as mentioned earlier, the increased seed cane acreage required for the billet planting system does represent an opportunity cost to the grower. The increased seed cane acreage required for the billet planting system results in a reduction of sugarcane acreage that could be harvested for sugar per 100 acres of plant-cane planted. This per acreage unit loss of income is a non cash cost which must be considered when evaluating the economic feasibility of billet planting. And finally, any potential yield differences due to planting method should also be considered as having a direct impact on the relative economics of billet planting versus whole-stalk planting.

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