Wisconsin Department of Agriculture
Trade and Consumer Protection

2010 Grant Project Final Report
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Feasibility Study to Evaluate the Viability of Growing Sweet Potatoes for Frozen Fry Processing in Central Wisconsin

Submitted by
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Overall Project Introduction

This study began two years ago to investigate the economic feasibility of growing sweet potatoes for frozen fry processing in central Wisconsin. Sweet potato is a member of the morning glory family, and is most commonly grown in the southern region of the United States (i.e. North Carolina, Louisiana, Mississippi). Optimal growing conditions require an average daily temperature of 77 degrees, and these conditions mostly exist in the southern states. Sweet potatoes are most commonly utilized as a fresh vegetable, and can be used for chips, canning and baby food. Recently the utilization of sweet potatoes has increased as frozen processors started making French fries and roasted cubes for the retail market.

McCain Foods USA in Plover, Wisconsin is a major frozen processor of Irish potatoes. More recently McCain has responded to market demands and has begun to process sweet potatoes into various types of French Fries and roasted cubes. Since local supply of sweet potatoes is limited, McCain Foods mostly sources sweet potatoes from growers in the south. Initially, only the off-grade roots (US #2) were utilized to make processed products. However the increased demand for processed sweet potato products has nearly exhausted the supply of off-grade roots. Furthermore, the distance from the southern regions involves significant shipping costs and quality deterioration of the roots while in transit.

Importance to Wisconsin

This study continued to explore the potential establishment of a processed sweet potato industry in Wisconsin. If successful, this industry would allow an additional crop to be included in the rotations of potato and vegetable growers in central Wisconsin. There is also potential that a processed sweet potato industry could spawn additional industry such as fresh, chip, or canned sweet potato products in the region. The near term goal is to establish 500-to-1, 000 acres of sweet potato production in Wisconsin. The farm gate value of this crop could exceed $2.4 million dollars in gross farm income and provide employment for hundreds of people.

Project Objectives

The objective of this project is to examine the competitiveness of locally grown sweet potatoes as compared to sweet potatoes grown in the southern U.S. for the purpose of processing them into frozen fried products. The objective was met by the establishment of nearly 110 acres of sweet potatoes on six cooperating farms in Wisconsin. The cooperating farms in order of most acres were: 1.) Robert Heath Farms, 32 acres, 2.) Joe Sies, 30 acres, 3.) Adam Flyte, 15 acres, 4.) Mike Holley, 12 acres, 5.) Bill Bradshaw, 11 acres, and 6.) Mike Lauer, 10 acres. In comparison, the 2008 study encompassed 21 acres on five cooperating farms.

Project Results

The project provided data for total yield, usable yield, and production expenses to compare the competitiveness of sweet potatoes sourced from Wisconsin farms with sweet potatoes purchased from southern growers/packers. Although listed as a cooperative farm, this study excludes yield/grade data from the Bill Bradshaw farm due to severe hail damage, in addition to the Mike

Lauer Farm, where slips delivered were in poor condition and the wrong variety for our growing area.

Table one shows the planting dates, between row spacing, in-row spacing, and harvest dates. Planting dates ranged from May 22nd to June 10th. Between-row spacing ranged from 34 inches to 38 inches, and in-row spacing ranged from 12-to-14 inches. Two farms started harvest in September while the remaining farms began at the end of the first week of October.

Table 1. *Cooperating farms, acreages, row spacing, and harvest dates*

Farm Name	Acres	Planting Date	Row Spacing (Inches)	Plant Spacing (Inches)	Harvest Start Date	Harvest Finish Date
Robert Heath	32	June 7	36	12	October 7	October 9
Joe Sies	30	May 28	36	12	September 28	October 10
Adam Flyte	15	May 25	34	14	September 24	September 27
Mike Holley	13	May 22	36	12	October 7	October 9

Table 2 lists the fertilization levels for each farm, and demonstrates the low levels of nutrients needed to grow sweet potatoes. Nitrogen fertilization levels ranged from 67-to-128 lbs. per acre, with an overall average of 111 lbs. per acre. Three farms utilized phosphate fertilizer, which ranged from a low of 45 lbs. to a high of 72 lbs. per acre. The highest level of fertilization occurred with K_2O, with a farm average of 176 lbs. per acre.

Table 2. *Fertilization Levels (Actual)*

Farm Name	N	P_2O_5	K_2O	CA	S	Mg	Micro
Robert Heath	122	47	45	0	0	0	0
Joe Sies	126	68	240	32	105	0	0
Adam Flyte	128	72	218	21	56	0	0
Mike Holley	67	0	202	21	62	11	0
Averages	**111**	**47**	**176**	**19**	**56**	**3**	**0**

All fields in the study were irrigated with overhead irrigation systems when soil moisture levels were below 50% ASM. Broadleaf and grass weeds were controlled using a tank mixture of Command 3ME (1.5 qts. /acre) and Devrinol 50 DF (2 lbs./acre), and was applied ground broadcast shortly after transplanting. Later application included the herbicide Poast for control of emerged grasses.

Table 3 shows the yield data for four of the largest cooperating farms representing 82 percent of the total acreage, or 90 acres in the study (column 1). Total yield ranged from 163-to-209 cwts per acre resulting in a collective total of 16,742 cwt. of sweet potato roots being harvested (column 2). The combined average gross yield for the study was 187 cwt per acre (column 3), of which 3.3 percent by weight was dirt, rock and foreign material (DRFM), (column 4). The DRFM percentage subtracted from the total potatoes, results in a 1st Net volume of 16,190 cwt. (column 5). Total culls listed in column 6 represent the percentage of mechanical or insect damaged roots, and is added to the percentage of undersized roots (process smalls) listed in column 7, and this becomes the second net volume (column 8). The 2nd net volume can then be converted to a percentage of prime payable roots (column 8), and this number is utilized to calculate the 2nd net yield (column 8). The prime payable (column 9) is the percentage of 1st net weight that is usable and expressed numerically in column 10.

Table 3. *Total yield, dirt, rock, foreign material, percentage culls, second net, prime payable,*

1 Acres	2 TOTAL POTATOES (CWT.)	3 GROSS YIELD (CWT./ACRE)	4 DRFM %	5 1ST NET (CWT)	6 TOTAL CULLS %	7 PROCESS SMALLS (<1.75") %	8 2ND NET (CWT)	9 PRIME PAYABLE %	10 PRIME PAYABLE YIELD (CWT./ACRE)
90	16,742	187	3.3	16,190	3.1	7.7	14,441	89.2	159

* *Excludes 10 acres from Lauer Farms and 11 acres from Bradshaw Farms*

Table 4 shows the composite average for the root size categories and defect levels. Each column shows the percentage of roots by weight that fell into each diameter category. There was 7.7% of the roots sized below 1-3/4 inch, and 10.1 percent in the 1-3/4 inch-to-<2-inch category. The percentage of process smalls is important because roots below 2 inches are difficult to process, and are excluded from southern sourced sweet potato contracts. The data shows the combined percentage of <2-inch roots is 17.1% for Wisconsin grown sweet potatoes, and demonstrates that a 2-inch minimum contract would not be feasible at this time.

Table 4. *Composite Average for Root Grades*

ROOT DIAMETER CATEGORIES				DEFECT LEVELS (PERCENT)				
<1-3/4 Inch %	>1-3/4-to-2 Inch %	>2-to-4 Inch %	>4-to-6 Inch %	Dry Rot %	Soft Rot %	Total Rot %	External Defects %	Internal Defects %
7.7	10.1	79.5	0.1	0.9	1.6	2.6	0.4	0.0

Loose Bulk Storage Trial

Beginning on October 7th approximately 3,047 cwt of sweet potato roots were stored loose bulk on the floor of the rented storage unit to examine the effects of non-traditional handling and storage practices (figure 1). Sweet potatoes are traditionally hand-harvested and stored in stackable containers (Figure 2). For this trial, the sweet potato roots were mechanically harvested into field trucks and then sorted and transloaded into semi-trailers at the field edge prior to delivery. While there was minimum damage to the roots in the mechanical lifting process, the roots were severely skinned in the transload and sorting operation.

Within two weeks the pile began to deteriorate and the trial had to be terminated. The roots were then scheduled for delivery during the first production run on November 6th. Approximately 450 cwts had to be discarded due to excessive soft rot, and the remaining volume was washed prior to delivery. Total shrink was estimated to be 17.3% compared to 10% for traditional bulk bin storage.

Causes for the problems were determined to be excess dirt in the pile, which limited airflow and excessive skinning of roots due to rough handling during the transloading and sorting process, which was conducted on equipment that is not properly designed for sweet potato handling. Potential mitigation practices in the future will involve reducing the number of times sweet potato roots are handled by avoiding in-field transloading and sorting. Unloading and sorting will occur at the storage facility. In addition, Irish potato handling equipment is designed to

handle high volumes with fast conveyer speeds. Fast conveyors result in excessive skinning of delicate sweet potato roots. A need for modifying regular potato equipment will be made prior to crop year 2010 harvest.

Figure 1. *Loose bulk storage trial*

Figure 2. *Traditional storage of sweet potato*

Table 5 shows the 2009 cost of production and per acre net return analysis for producing sweet potatoes in central Wisconsin. Total cost of production (line 6), was calculated to be $2,247.11 per acre. Gross receipts (line 1), were calculated using a single-size cull (<1-3/4 inch), with a contract value of $15.00 per cwt. The $15.00 per cwt contract price best represents current

competitive pricing with sweet potatoes sourced from the southern growing regions, and calculates to $2,385.00 gross receipts per acre, resulting in a net profit of $137.89 per acre (6.1% return on investment). The breakeven price was calculated at $14.13 per cwt.

Table 5. *2009 Per Acre Cost of Production for Wisconsin Grown Sweet Potatoes*

SWEET POTATOES - FOR PROCESSING MARKET - IRRIGATED				
ESTIMATED COSTS AND RETURNS PER ACRE, 2009				
BASED ON CWT- HARVEST EARLY OCTOBER				
	UNIT	**QUANTITY**	**PRICE OR COST/UNIT**	**TOTAL PER ACRE**
1. GROSS RECEIPTS				
U.S. NO. 2 PROCESSING (w/ <1.75 inch Cull)	CWT.	159	$15.00	**$ 2,385.00**
TOTAL RECEIPTS AND AVERAGE PRICE				
2. VARIABLE COSTS				
TRANSPLANTS	PER THOU.	14	$35.00	$ 490.00
TRANSPLANT FERTILIZER (9-18-9) & ROOT DIP	GAL.	2	$7.00	$ 14.00
BROADCAST FERTILIZER (17-17-17)	LBS.	250	$0.22	$ 55.00
1ST SIDEDRESS FERTILIZER (32%)	GAL.	15	$1.24	$ 18.60
1ST FERTIGATION (32%)	GAL.	7	$1.24	$ 8.68
2ND FERTIGATION (32%)	GAL.	7	$1.24	$ 8.68
HERBICIDES		2	$18.00	$ 36.00
Command	QUARTS	1.5	$32.00	$ 48.00
Devrinol	LB	2	$10.60	$ 21.20
TRANSPLANT LABOR	HRS/ACRE	13.33	$15.00	$ 199.95
CULTIVATION	ACRE	2	$9.00	$ 18.00
HAND WEEDING	ACRE	1	$50.00	$ 50.00
IRRIGATION MACHINERY AND LABOR	ACRE	1	$40.00	$ 40.00
HARVEST LABOR (HOURLY)	ACRE	1	$100.00	$ 100.00
HARVEST LABOR (PIECE RATE)	ACRE	1	$352.00	$ 352.00
BULK BINS	EACH	15	$12.00	$ 180.00
TOTAL VARIABLE COSTS				**$ 1,640.11**
4. FIXED COSTS				
TRACTOR/MACHINERY	ACRE	1	$40.00	$ 40.00
IRRIGATION	ACRE	1	$35.00	$ 35.00
TOTAL FIXED COSTS:				**$ 75.00**
5. OTHER COSTS				
LAND RENT	ACRE	$ 250.00		$ 250.00
GENERAL OVERHEAD	DOL	$ 2,247.11	0.06	$ 117.00
STORAGE	CWT	$ 1.00		$ 165.00
TOTAL OTHER COSTS:				**$ 532.00**
6. TOTAL COSTS				**$ 2,247.11**
BREAK-EVEN AVERAGE YIELD (Cwt/Acre)			***BREAK-EVEN AVG PRICE PER CWT.***	
159	(W/<1.75 inch cull)		**$**	**14.13**

Key Personnel

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Conclusions and Recommendations

The 2009 growing season was again much cooler than normal. Accumulated heat units at the end of August were 87.2% of the 20-year average, and 86.4% of the 5-year average. A warmer than normal September promoted rapid root development, however total yield and payable yield declined 4.5 % compared to crop year 2008.

Trial results showed that the feasibility of growing sweet potatoes with a <1/3/4 cull contract is marginally feasible if the grower is expected to pay all production costs. The net return per acre was $137.89 per acre, or a 6.1% return on investment. Although included in the cost of production analysis, growers are not currently paying for the bulk bins or storage costs.

A storage building with climate control was utilized to store the roots in stackable boxes. This facility proved adequate in crop year 2009. Associated costs (building rental and utilities) were calculated to be approximately $1.00 per cwt. Floor space within the same building was utilized for the loose bulk trial, which was not successful.

Several Mechanical harvesting methods were explored and each showed potential promise. Successful mechanical harvesting would reduce production costs if roots could be stored loose bulk (no containers). A preliminary comparison of per acre costs for mechanical harvesting vs. hand harvesting proved counter intuitive, as each method was similar in costs.

Agronomic trials scheduled in crop year 2010 are targeted towards increasing the usable yield to a more feasible 180 cwts. per acre. Current studies underway include: 1) plant spacing trial 2) bedding trial 3) muck trials 4) examining the variety Evangeline.