Wisconsin Department of Agriculture
Trade and Consumer Protection

2008 Grant Project Final Report
WDATCP Contract No. 23046

Feasibility Study to Evaluate the Viability of Growing Sweet Potatoes for Frozen Fry Processing in Central Wisconsin

Submitted by
McCain Foods USA

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Overall Project Introduction

This project began one year ago to investigate the economic feasibility of growing sweet potatoes for frozen fry processing in Wisconsin. Sweet potato, a member of the morning glory family, is commonly grown in the southern region of the country (i.e. North Carolina, Louisiana, Mississippi). It is a plant adapted to the hot and humid conditions occurring in the southern states. Sweet potatoes are most commonly sold as a fresh vegetable. Sweet potatoes are also used for chips, canning and baby food. More recently, they are also used in frozen processing to make French fries and roasted cubes.

McCain Foods USA in Plover, Wisconsin is a major frozen processor of Irish potatoes. In recent years it has begun to process sweet potatoes to make various types of French fries and roasted cubes. McCain Foods must source sweet potatoes from growers located in the south, since there is no local supply of sweet potatoes. Predominantly, off-grade roots (US # 2) are purchased to make processed products. However, the increasing demand for processed sweet potato products will soon exhaust the supply of off-grade roots. Furthermore, the distance from current raw supply involves significant cost of shipping. Finally, the extended amount of time it takes to ship off-grade roots from southern locations increases the deterioration of the roots while in transit, which results in more unusable raw product delivered to the factory.

Importance to Wisconsin

This study examines the potential establishment of a processed sweet potato industry in Wisconsin. If feasible, this industry will allow an additional crop to be included in the rotations of potato and vegetable growers in central Wisconsin. A processed sweet potato industry could also spawn a fresh, chip, or canned sweet potato industry. A near term goal is to establish 500-to-1,000 acres of sweet potato production in Wisconsin. Gross returns per acre could result in $2-to-$4 million in gross farm income.

Project Objectives

The objective of this project is to examine the feasibility of growing sweet potatoes in central Wisconsin for the purposes of processing them into frozen, fried products. The objective was met by the establishment of 21.1 composite acres of sweet potatoes on five cooperating farms in central Wisconsin. The 2008-year cooperating farms and acreage of each is as follows: Bill Bradshaw Farms (1 acre), Adam Flyte (3 acres), Robert Heath (12 acres), Mike Holley (3.1 acres), and Joe Sies (2 acres). The 2008 ADD grant goal was to grow 6 acres between two farms.

Project Results

Sweet potatoes are currently sourced by McCain Foods USA-Plover, WI from farms/packers in the southern region of the United States (i.e. North Carolina, Louisiana) on a 2-inch to 8-inch process grade. This project provided data for the yield,

quality, and production expenses necessary to judge whether sweet potatoes sourced from Wisconsin farmers can be cost competitive with sweet potatoes purchased from southern growers/packers.

Table one shows the planting dates, between-row spacing, and in-row spacing and harvest dates. Planting dates ranged from May 23rd until June 11th. Between-row spacing ranged from 34 inches to 38 inches, and in-row spacing ranged from 12 to13 inches. All farms were harvesting roots during 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
Bill Bradshaw	1	June 12	38	12	September 25th	September 28th
Mike Holley	3	May 23	36	12	September 15th	October 3rd
Adam Flyte	3	May 24	34	12	October 1st	October 3rd
Bob Heath	12	June 11	38	13	October 6th	October 9th
Joe Sies	2	May 24	36	12	October 1st	October 3rd

Table 2 lists the fertilization levels for each farm, and is indicative of the sustainable low levels of fertilization required to grow sweet potatoes. The fertilization levels for the Bradshaw farm are not listed because they did not utilize synthetic fertilizers in their organic production.

Nitrogen fertilization levels ranged from 58 lbs. per acre to 126 lbs. per acre. Pounds of actual nitrogen averaged only 92.3 lbs per acre. Only two farms added phosphate, which ranged from 64-to-72 lbs. per acre. The highest level of fertilization occurred with K_2O, with an average of 130 lbs. per acre applied.

Table 2. *Fertilization Levels (Actual)*

FARM NAME	N	P_2O_5	K_2O	CA	S	MG	MICRO
Joe Sies	58	72	262	0	34	11	0.5
Robert Heath	109	64	32	0	4	0	0
Mike Holley	126	0	106	21	61	0	0
Adam Flyte	76	0	120	21	20	0	0
Averages	**92.3**	**34.0**	**130.0**	**10.5**	**29.8**	**2.8**	**0.1**

All fields were irrigated with overhead irrigation systems when needed (<50% ASM). Only one farm utilized chemical weed control (Devrinol and Command tank mix), the remaining farms employed hand weeding as needed. No farm applied insecticides since there are currently no insect pests identified in Wisconsin for sweet potatoes, and no diseases, were noted throughout the growing season.

Table 3 shows the composite average of root grades for the five farms. Each column shows the percentage of roots by weight that fell into each diameter category. There was 14.0 percent of the roots sized below 1-3/4-inch, while in the 1-3/4-to-<2 –inch

category, there was an additional 10.4 percent of the roots. These two categories combined (24.4%), equal the total undersize category identified as process smalls (< 2 inches). The percentage of process smalls is important because roots below 2 inches are difficult to process and would be normally identified as culls. In Table 3 the percentage of culls (0.9%) was indicative of mechanical damage or various rots. Most of the roots (72.9%) measured between 2.0-to-4.0 inches in diameter (column 6). The last column represents the percentage of total prime payables. A total of 73.4 percent of the roots were usable for processing, thus this represents the percentage of total root weight the growers would be paid on.

Table 3. *Composite Average for Root Grades*

<1-3/4 INCH %	1-3/4-TO-2.0 INCH %	PROCESS SMALLS (<2") %	CULLS %	2.0-TO-4.0 INCH %	4.0-TO-6.0 INCH %	Total Prime Payables %
14.0	10.9	24.9	0.9	72.9	0.5	73.4

Table 4 shows the total yield average for the five farms. Inclusively, these farms produced an average total yield of 195.4 cwt./acre. The total yield was calculated from the total root weight minus the weight of dirt, rock, and foreign material. The cull yield, which included roots with physical damage or rot, averaged 1.7 cwt. per acre. The third and fourth columns from the left shows the per acre yields of <1-3/4 inch and 1-3/4 to <2 inch roots, which was 27.3, and 21.4 cwt. per acre respectively. The total yield of process smalls (<2 inches) is the sum of columns 3 and 4, or 48.7 cwt. per acre. What remains after the culls and undersized roots are subtracted from the total yield is called the prime payable yield (columns 6 & 7). This is the yield that is payable for the producer after the yield of culls and process smalls are subtracted. For this study, the prime payable yield was calculated using a <1-3/4 inch cull in addition to a standard contract cull of <2 inches. The prime yield utilizing a <1-3/4 inch cull contract would have resulted in a 166.4 cwt per acre payable yield to the producer. When a <2 inch cull contract is calculated, the payable yield is reduced to 145 cwt. per acre.

Table 4. *Total yield, cull yield, process small yield, and prime payable yield*

TOTAL YIELD (CWT./ACRE)	CULLS (CWT./ACRE)	<1-3/4 INCH YIELD (CWT./ACRE)	1-3/4 INCH-TO-<2 INCH YIELD (CWT./ACRE)	TOTAL PROCESS SMALLS (CWT/ACRE)	PRIME PAYABLE YIELD W/ <1-3/4 CULL (CWT/ACRE)	PRIME PAYABLE YIELD W/<2INCH CULL (CWT/ACRE)
195.4	1.7	27.3	21.4	48.7	166.4	145.0

Table 5 shows the 2008 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 $2,759.38 per acre. Gross receipts (Line 1) were calculated using two different sizes of culls (<2-inch, and <1-3/4 inch), with a contracted value of $18.00 per cwt. value. When a <2 inch cull is utilized, the net payable yield of 145 cwt. per acre results in a gross return per acre of $2,610, which represents a net loss of ($149.38) per

acre (Line 7, Table 5). A U.S. No. 2 processing contract with a <1-3/4 cull, would result in a gross per acre return of $2,995.20, and a net profit of $235.82 per acre

Table 5. *2008 Per Acre Cost of Production for Wisconsin Sweet Potatoes*

SWEET POTATOES - FOR PROCESSING MARKET - IRRIGATED					
ESTIMATED COSTS AND RETURNS PER ACRE, 2008 BASED ON 12 acres- HARVEST EARLY OCTOBER					
	UNIT	QUANTITY	PRICE OR COST/UNIT		TOTAL PER ACRE $
1. GROSS RECEIPTS					
U.S. NO. 2 PROCESSING (w/ <2-inch Cull)	CWT.	145.0	$18.00	$	2,610.00
U.S. NO. 2 PROCESSING (w/ <1.75 inch Cull)	CWT.	166.4	$18.00	$	2,995.20
2. VARIABLE COSTS					
TRANSPLANTS	PER THOU.	15	$35.00	$	525.00
TRANSPLANT FERTILIZER	GAL.	2	$12.00	$	24.00
1ST SIDEDRESS FERTILIZER (9-18-9)	GAL.	15	$12.00	$	180.00
2ND SIDEDRESS FERTILIZER (9-18-9)	GAL.	15	$12.00	$	180.00
3RD SIDEDRESS FERTILIZER (32%)	GAL.	7	$2.37	$	16.59
HERBICIDES	ACRE	1	$18.00	$	18.00
TRANSPLANT LABOR (HAND CREW) *	HRS./ACRE	12.5	$20.00	$	250.00
CULTIVATION	#/ACRE	4	$15.00	$	60.00
HAND WEEDING	ACRE	1	$50.00	$	50.00
IRRIGATION MACHINERY AND LABOR	ACRE	1	$40.00	$	40.00
HARVEST LABOR (HOURLY)	HRS./ACRE	10	$22.00	$	220.00
HARVEST LABOR (PIECE RATE)**	ACRE	1	$405.77	$	405.77
BULK BINS	EACH	20	$12.00	$	240.00
TOTAL VARIABLE COSTS				**$**	**2,209.36**
3. FIXED COSTS					
TRACTOR/MACHINERY	ACRE	1	$25.00	$	25.00
IRRIGATION	ACRE	1	$55.00	$	55.00
TOTAL FIXED COSTS:				**$**	**80.00**
4. OTHER COSTS					
LAND RENT	ACRE	$ 275.00		$	275.00
GENERAL OVERHEAD	DOL	$ 2,785.94	7%	$	195.02
TOTAL OTHER COSTS:				**$**	**470.02**
5. TOTAL COSTS				**$**	**2,759.38**
6. NET RETURNS PER ACRE					
AVERAGE YIELD (Cwt/Acre)		***NET RETURN PER ACRE***			
145.0 cwt. (w/<2 inch cull)		$ (-149.38)			
166.4 cwt (w/<1.75 inch cull)		$ 235.82			

*1.5 days x10 people x 10 hours each x $20.00 per hour=$3,000/12 acres=$250 per acre

** Total piece rate pay for 12 acres was $4,860/12 acres=$405.77 per acre

Key Personnel

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Conclusions and Recommendations

The 2008 growing season was much cooler than normal. Despite the cool temperatures, the roots sized nicely in the month of September. Accumulated heat units at the end of August were 7.5% below the 5-year average, most likely adversely affecting the yield and grade of the heat-loving sweet potato.

Trial results indicated that the feasibility of growing sweet potatoes with a <2 inch cull and $0.18 per pound contract may not be feasible in Wisconsin. A <2 inch cull contract would have resulted in a net loss of ($149.38) per acre in crop year 2008. When a <1-3/4 inch cull is utilized with an $0.18 cent per pound contract ($18.00/cwt.), a net profit of $235.82 per acre was realized. In the future, both categories of culls will be utilized to calculate grower net returns.

In crop year 2009, anticipated changes will involve altering the planting dates to early June instead of late May, thus delaying planting until the soil is warmer (>60 degrees). In addition, an evaluation of greenhouse transplants is planned this season to examine if earlier vine growth can be obtained with transplants compared to standard slip planting thus expediting early season vine growth. Also, to reduce harvest costs, a means to facilitate easier mechanical harvesting will be examined that will alter hill structure making it easier to shred vines in addition to exploring the use of coulters along side each hill to severe vines. Sweet potato vines proved too troublesome for effective mechanical harvesting in 2008.

After harvest a consolidated storage building with climate control will be utilized to store the entire volume of roots from each grower. Normal storage consists of storing sweet potatoes in plastic bins, which have to be emptied before shipping and processing. An on-floor loose bulk storage system utilized in the storage of Irish potatoes will be explored for storing sweet potatoes. If successful, this method will reduce handling costs before shipping roots.

It is recommended that this study be continued for another 2 years to decrease the effect of seasonal weather on yield and grade, and to explore further agronomic methods and newer sweet potato varieties that will potentially increase yields to more profitable levels.