AgBioForum, 20(1): 37-45. ©2017 AgBioForum.

Economic and Environmental Benefits of Biotech Potatoes with Traits for Bruise Resistance, Late Blight Resistance, and Cold Storage

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In 2015 biotech potatoes re-entered the US market after a hiatus since 2001. The JR Simplot Company received regulatory approval for its Innate® 1.0 potatoes that have traits for low acrylamide and resistance to bruising and discoloration. Simplot submitted for regulatory approval its Innate® 2.0 potatoes that have the 1.0 traits plus late blight resistance and cold storage capability. This study estimates US benefits for three of the four Simplot traits, with the acrylamide trait not included. Estimates were constructed from US Department of Agriculture data, published research, and interviews with industry experts. Total economic benefits are estimated at $740 million annually. Grower production costs per cwt could go down 28%. Environmental benefits include a reduction of 2.5 million acre-applications of pesticides, 740 million fewer pounds of CO_2 emitted, and 84 billion gallons less water used.

Key words: *a priori* analysis, biotechnology, bruising, cold storage, Innate® potatoes, late blight, line selection, sustainability.

Introduction

History

Biotech potatoes entered the North American market in 1995 when Monsanto subsidiary NatureMark rolled out its Newleaf™ brand. The product provided benefits to farmers, processors, consumers, and the environment. According to Kaniewski and Thomas (2004), the biotech potatoes helped growers reduce pesticide sprays and production costs. Processors benefitted from a higher quality raw product with less net necrosis, and consumers purchased potato products at no increase in costs. For the whole US potato crop, the NewLeaf™ potatoes significantly reduced the 2.6 million pounds of pesticides applied each year (Brookes & Barfoot, 2005; Phipps & Park, 2002). In spite of the benefits, Monsanto exited the biotech potato market in 2001 due to acceptance issues with quick service restaurants (QSRs) and international markets (Halterman, Guenthner, Collinge, Butler, & Douches, 2015).

Other researchers confirmed that the use of GM potatoes could decrease pesticide use and increase grower profits (Flannery, Thorne, Kelly, & Mullins, 2005; Marra, Pardey, & Alston, 2002). Less pesticide use and reduced crop losses through biotechnology also appeal to potato growers in developing countries (Curtis, McCluskey, & Wahl, 2004; Huesing & English, 2004). GM potatoes developed at Michigan State University were field tested in South Africa and Egypt and confirmed to control the potato tuber moth (PTM), a pest that can cause severe losses in yield and quality. Researchers found the PTM-resistant potatoes could increase food security, reduce food prices, increase farm profitability, and protect the environment in those two countries (Guenthner, Araji, & Maredia, 2004). Growers in South Africa could save the costs of applying nine different insecticides typically used to control PTM. Resource-poor farmers who cannot afford pesticides would benefit from better yields and quality.

Efforts to develop and commercialize biotech potatoes have continued around the globe, but outside North America only three varieties have received government approval (International Service for the Acquisition of Agri-Biotech Applications [ISAAA], n.d.). Amflora, a high-starch potato developed by BASF, was approved in Europe, but is no longer marketed. The other two, Elizaveta Plus and Lugovskoi Plus, are insect-resistant varieties developed by the Russian Academy of Sciences. BASF also developed the varieties Modena, Amadea (both with increased amylopectin), and Fortuna (with late blight resistance). In 2013, BASF halted its pursuit of regulatory approval for all its GM potato varieties because continued investment cannot be justified due to uncertainty in the regulatory environment and threats of field destructions (Sawaya, 2014).

Market Entry

The JR Simplot Company began efforts to enter the biotech potato business at about the time that Monsanto abandoned it in 2001. Rather than developing producer traits and possibly facing the same marketing difficulties encountered by Monsanto, Simplot focused on consumer traits for its first biotech potato products. In order to address possible consumer acceptance issues, Simplot used only potato genes for trait introduction. Intragenic products have been viewed by many as more likely to be accepted than transgenic products (Toevs, Guenthner, Johnson, McIntosh, & Thornton, 2011a). Other researchers found that US consumers are willing to pay more for biotech potatoes with health-enhancing traits, especially if they were produced with intragenic technology (Huffman & McCluskey, 2014; Huffman, Shogren, Rousu, & Tegene, 2003).

Simplot's first target trait was reduced acrylamide, a substance linked to birth defects and cancer in rats, and found in foods cooked at high temperatures. Anticipating potential demand for low-acrylamide processed potato products, Simplot developed potatoes with a low potential for producing acrylamide. The second consumer trait was bruise/browning resistance, which could reduce food waste and open new avenues for marketing fresh-cut potatoes.

In 2013, Simplot submitted a petition to the US Department of Agriculture, Animal and Plant Health Inspection Service (USDA APHIS) seeking nonregulated status for its Innate® 1.0 potato with low acrylamide and bruise resistance traits. Simplot received approval from the USDA in 2014. The Environmental Protection Agency (EPA) and the Food and Drug Administration (FDA) followed with approval in 2015, opening the door for Simplot to commercialize Innate® 1.0 in Atlantic, Ranger Russet, and Russet Burbank potatoes.

Before marketing Innate® potatoes, Simplot developed and implemented an identity preservation (IP) system using some practices identified in a survey of potato industry experts (Toevs et al., 2011b). In May 2015, the Innate® 1.0 potatoes entered the fresh, fresh-cut, and chip market channels, contracting with licensed growers and handlers who agreed to follow the requirements of Simplot's IP program. Simplot chose not to enter the frozen processing and dehydration market channels in 2015. The company also submitted a petition to USDA APHIS for Innate® 2.0 potatoes that have the same 1.0 traits plus late blight resistance and cold storage capability.

Objectives

The overall objective was to evaluate potential benefits of three of the four traits in Innate® 1.0 and 2.0 potatoes. Specific objectives were to estimate

1. economic and environmental benefits of the bruise-reduction trait,
2. economic and environmental benefits of the late-blight-resistance trait,
3. economic and environmental benefits of the cold-storage trait, and
4. changes in production costs for potato growers.

Methods

Scope

Since Innate® potatoes have not been on the market long enough for empirical analysis, this *a priori* study relies on assumptions to estimate benefits. In the future, an *ex post* analysis using actual market data could supplement this study. Since this analysis focuses on traits rather than commercial products, it evaluates the benefits of potato product improvements. Results can help answer the question of what would be the environmental and economic impacts if all US potatoes in selected market sectors had these traits.

Although bruising causes quality problems in all market sectors, we focused on the fresh market, where bruise damage is most apparent to consumers. Since late blight affects all potato market channels we estimated impacts for all US potatoes for that trait. Regarding the cold storage trait, we estimated benefits for stored potatoes in the processing market channel. Since fresh potatoes are already stored at colder temperatures, we assumed that the cold storage trait had insignificant benefits in that market sector. We understand that potato growers' ability to store potatoes for both fresh and processed markets in the same storage at the same temperature gives them more market flexibility, but we did not attempt to quantify that benefit.

Data

We used three categories of data—1) secondary government data, 2) published research results, and 3) primary data from expert interviews. The first category includes information on production, markets, and prices for the US potato crop (Table 1) in 2013, the year before Innate potatoes were approved for commercialization. The main source was the USDA National Agricultural Statistics Service (NASS, 2014). Other sources of second-

Table 1. 2013 US potato crop data.

All potatoes	Amount	Sources
Quantity (cwt)	434,652,000	USDA NASS (2014)
Yield (cwt/acre)	407.3	USDA NASS (2014)
Acres	1,067,067	USDA NASS (2014)
Price: grower ($/cwt)	$9.71	USDA NASS (2014)
All fresh potatoes		
Quantity (cwt)	104,326,000	USDA NASS (2014)
Price: grower ($/cwt)	$12.98	USDA NASS (2014)
Price: retail ($/lb)	$0.67	US BLS (n.d.)
Fresh russet potatoes		
Quantity (cwt)	74,218,000	USDA AMS (n.d.), Huffaker (2015)
Price: grower ($/cwt)	$8.39	USDA AMS (n.d.), Huffaker (2015)
Price: packer ($/cwt)	$15.75	USDA AMS (n.d.), Huffaker (2015)
Price: retail ($/cwt)	$50.00	Expert opinion
Price: food service ($/cwt)	$42.00	Expert opinion
Processed potatoes		
Quantity, processed (cwt)	276,110,000	USDA NASS (2014)
Fall crop share of total	89%	USDA NASS (2014)
Share of fall crop stored	81%	USDA NASS (2014)
Yield, fall crop (cwt/acre)	425	USDA NASS (2014)
Share of processed: frozen	57%	USDA NASS (2014)
Share of processed: dehy	17%	USDA NASS (2014)
Share of processed: chips	22%	USDA NASS (2014)
Share of processed: other	4%	USDA NASS (2014)
Convert raw to final, frozen	2	Guenthner (2001)
Convert raw to final, dehydration	7	Guenthner (2001)
Convert raw to final, chips	4	Guenthner (2001)
Price, grower all processed ($/cwt)	$8.56	USDA NASS (2014)
Price, frozen fries, food service ($/lb)	$6.44	Basic Media Group (2015)
Price, dehydration retail ($/lb)	$3.36	USPB (2015)
Price, chips retail ($/lb)	$4.73	US BLS (n.d.)

ary data include the USDA Agricultural Marketing Service (AMS, n.d.), the US Bureau of Labor Statistics (BLS, 2015), the US Potato Board (USPB, 2015), Basic Media Group (2015), Guenthner et al. (2001), and Huffaker (2015). The purpose of the data in Table 1 is to provide a base from which to estimate impacts of the improved potato traits.

The second data category includes findings from published research (Table 2). The purpose of this dataset is to provide *a priori* assumptions used to calculate Innate benefits. Environmental assumptions came from Field to Market (2015a), university research on potato production practices and costs (Mitchell, 2013; Patterson, 2013), and a study on the economics of potato late blight (Guenthner, Michael, & Nolte, 2001). Field to Market (2015a) provides metrics for environmental benefits of changes in agricultural practices that we used to estimate CO_2 emission and water-use benefits. University research on potato production practices and costs (Mitchell, 2013; Patterson, 2013) enabled us to estimate economic and environmental benefits of reduced pesticide applications.

Since Innate potatoes have only been commercialized for a short time, we sought information from other research projects to estimate impacts of blight resistance. The study by Guenthner et al. (2001) included an expert opinion survey using the Delphi method to arrive at group consensus regarding late blight impacts. One impact was an estimated 5% yield loss due to inadequate late blight control. Although that expert survey was conducted in 2000, late blight continues to be a serious problem. We assumed that the 5% loss is still on target in 2015. Another key assumption was the loss of storage potatoes due to inadequate late blight control. We used that study's figure of 1.7% storage loss.

Some data in Table 2 deals with potato waste, shrink and loss linked to bruising, and cold storage traits. The gap between the amount of potatoes produced and the amount sold begins in the field where bad weather and pests can leave some potatoes unharvested. For fields that are harvested, some tubers are left in the field. For the 2010-2014 crops the average amount of potatoes left in Idaho fields ranged from 8% in 2010 to 5% in 2014 (USDA NASS, 2014).

There are additional losses for tubers that make it out of the field. According to Buzby, Hyman, Stewart, and Wells (2011), 7% of fresh potatoes are lost at the retail link of the marketing chain. After accounting for that loss, another 28% is lost with consumers due to shrinkage (moisture loss), pest damage, greening, and waste. The total of 35% means that nearly 4 billion

Table 2. Assumptions for estimating potato trait benefits.

Item	Amount	Sources
Environmental		
CO_2 emissions (lb) to grow one cwt of potatoes	14.8	Field to Market (2015a)
Water use (gal) to grow one cwt of potatoes	1684	Field to Market (2015a)
Pesticide applications, average ID & WI (#/acre)	17	Patterson (2013), Mitchell (2013)
Late blight		
Late blight fungicide applications, ID & WI (#/acre)	7.5	Patterson (2013), Mitchell (2013)
Increased yield	5.0%	Guenthner et al. (2001)
Storage waste reduced	1.7%	Guenthner et al. (2001)
Cold storage		
CIPC application Nov (% of stored potatoes)	67%	Patterson (2013)
CIPC application Apr (% of stored potatoes)	27%	Patterson (2013)
Reduced storage shrink & loss	6.1%	Table 3
Bruising		
Reduced waste and rejections	9.1%	Table 4
Production costs (E ID)		
Operating costs ($/acre)	$1,976	Patterson (2013)
Operating costs ($/cwt)	$4.76	Patterson (2013)
Late blight and sprout control costs ($/acre)	$234	Patterson (2013)

pounds of potatoes are lost each year. The waste category is for edible food not consumed as a result of human action or inaction. One example is fresh potatoes that consumers discard after peeling because of unattractive bruising and internal discoloration. The results of the Buzby et al. (2011) research for frozen processed potatoes is similar. The researchers estimated that frozen potato losses from the food supply were nearly 3 billion pounds, 36% of the total supply.

Whenever consumers, growers, or anyone else on the marketing chain stores potatoes, shrink and loss occur. Researchers have long confirmed that storage temperature affects reductions in tuber weight and quality (Boe, Woodbury, & Lee, 1974; Guenthner, 1995; Iritani & Weller, 1977; Sparks, 1965, 1975; Varns, Schaper, & Preston, 1985). Sparks and Summers (1974) measured shrink and four categories of quality loss—rot, flat, shrivel, and sprouts—for potatoes stored at 45°F and 52°F. They found that after 11 months of storage, shrink and loss were 27.6% at the higher temperature and 11% at the lower temperature, a difference of 16.7% (Table 3). The simple average for all 11 storage months was 7.7%. To account for quantities of potatoes marketed each month out-of-fields and out-of-storages we used a more conservative weighted average of 6.1%, which we assumed would be the average reduction in storage loss for processed potatoes due to the cold storage trait.

Although potato storage technology and management expertise have improved since the Sparks and Summers (1974) research was conducted, the estimates are still appropriate for several reasons. First, potato physiology has not changed. Second, the researchers claimed that their figures were minimum, not average, shrink and loss for well-managed storages. Third, the cold-storage trait would allow processing potatoes to be stored at temperatures lower than 45°F with perhaps even less shrink and loss while still meeting processing quality standards for sugar content and fry color.

Expert Opinion

A literature search provided inadequate information to quantify the impact of bruise on shrink and loss so we obtained primary data from interviews with 11 experts in the fresh potato industry. Research by Lambrigger, Shevchenko, and Wuthrich (2007) demonstrated the use of expert opinion in economic analysis and Paini, Worner, Cook, De Barro, and Thomas (2010) documented the value of expert opinion in plant pest analysis. In order to fill missing gaps in our analysis we sought potato industry experts to provide opinions about potato bruising. Leaders in the US potato industry helped us identify people with relevant expertise.

We interviewed the experts in person and by phone. Experts were surveyed to estimate the percent losses that would no longer occur with the bruise resistance

Table 3. Estimated reductions in cold storage shrink & loss.

	Shrink %		Loss %*		Shrink + loss %		
Month	**45° F**	**52° F**	**45° F**	**52° F**	**45° F**	**52° F**	**Difference**
1	0.5	0.4	0.4	0.4	0.9	0.8	-0.1
2	1.5	2.0	1.2	1.7	2.7	3.6	0.9
3	1.8	2.6	1.5	2.1	3.2	4.7	1.5
4	2.2	3.3	1.9	2.7	4.1	6.0	1.9
5	2.5	4.5	2.1	3.7	4.6	8.2	3.6
6	3.0	8.4	2.5	7.0	5.5	15.3	9.8
7	3.7	9.9	3.1	8.3	6.8	18.1	11.3
8	4.2	10.7	3.5	8.9	7.8	19.6	11.8
9	5.1	11.8	4.2	9.9	9.3	21.7	12.4
10**	5.5	13.4	4.6	11.2	10.1	24.7	14.6
11	6.0	15.1	5.0	12.6	11.0	27.6	16.7
Average							7.7
Average weighted by monthly sales							6.1

Sources: Sparks (1965); Sparks and Summers (1974)
** Loss base is Month 11; assumed other months same rate of change as shrink*
*** Extrapolated as midpoint between adjacent months*

Table 4. Results of expert opinion interviews.

	Waste due to bruising			Rejections	
Market	**Before**	**After**	**Reduced**	**reduced**	**Total**
Grower	6.3%	4.5%	1.8%	0.25%	2.05%
Packer	5.0%	3.0%	2.0%	2.00%	4.00%
Food service	2.0%	0.5%	1.5%	0.03%	1.53%
Retailer	2.0%	0.5%	1.5%	0.03%	1.53%

and low-browning traits. They provided their estimates on two types of bruising impacts—waste and rejections (Table 4). We chose midpoints of answers when they varied over a range. This process quantified bruise impacts on four links of the marketing chain—growers, packers, food service, and retail.

Results

Bruising

We estimated the impacts of the bruise-resistance trait in two categories—fresh russets and all fresh potatoes. Russets make up 71% of the US fresh market (Table 1). Using the expert opinion data in Table 4, we estimated that the bruise-resistance trait—if it were in all fresh russet potatoes—would reduce potato waste by 400 million pounds worth $90 million (Table 5). Using Field to Market data in Table 2 we estimated environmental impacts of a reduction in CO_2 emissions of 60 million pounds and a water-use reduction of 6.6 billion gallons. These estimates are conservative because fresh potato rejections were not included in the calculations.

Since our expert opinion data on bruising included several links on the marketing chain, we were able to estimate impacts on US fresh potato growers, packers, retailers, and food service if all fresh potatoes (24% of the entire US crop) had the bruise-resistance trait. Using 2013 crop data, we estimated that 860 million pounds of potatoes would not be lost due to bruising (Table 6). With average potato yields (Table 1), 21,000 fewer acres would need to be planted to produce the same size crop. The unplanted acres would mean that about 360,000 acres of potato pesticide applications would not be made. Using metrics from Field to Market (2015a), we estimated that 130 million pounds of CO_2 would not be emitted and 14 billion gallons of water not used. These estimates are larger than those in Table 5 because they include all fresh potatoes and also include rejections.

Late Blight

Since late blight is a ubiquitous threat, we estimated impacts of late blight resistance for the entire US potato industry using data in Tables 1 and 2. Expert opinion research (Guenthner et al., 2001) provided data on potential fungicide use reduction due to the trait.

The late blight resistance trait is the most valuable, with an estimated economic impact of $420 million (Table 6). Of that total, $280 million was due to reduced potato waste from 2.91 billion pounds of potatoes no

Table 5. Estimated benefits for bruise trait in US fresh russet market.

Market	Potato waste reduced (million lb)	Value of waste reduction (million $)	CO_2 emissions reduced (million lb)	Water use reduced (billion gal)	Sprays reduced (acres)
Grower	130	$11	20	2.2	57,000
Packer	150	$23	22	2.5	63,000
Food service	50	$19	7	0.7	19,000
Retailer	70	$33	10	1.1	28,000
Total	400	$90	60	6.7	170,000

Notes: totals are rounded; rejections losses are not included

Table 6. Estimated benefits for bruise, late blight and cold storage traits.

Item	Bruise	Blight	Storage	Total
Innate® generation	Gen 1	Gen 2	Gen 2	Gen 1&2
Market	Fresh	All	Processed	N/A
Potato waste reduced (million lb)	860	2,910	1,190	4,960
CO_2 emissions reduced (million lb)	130	430	180	740
Water use reduced (billion gal)	14	49	20	84
Pesticide applications reduced (1,000 acres)	360	1,220	910	2,490
Plantings not needed (1,000 acres)	21	71	28	121
Grower costs of production saved (million $)	$40	$140	$60	$240
Value of potato waste reduction (million $)*	$100	$280	$120	$500
Total economic impact (million $)	$140	$420	$180	$740

** Grower value included for all; packer, retail, and food service included for bruise*

longer being lost due to potato bruising. If that amount of potatoes were saved from waste, potato plantings could be reduced by 71,000 acres. With reduced plantings, potato pesticide acre-applications would be reduced by 1.2 million. Using Field to Market (2015a) metrics, CO_2 emissions would decline by 430 million pounds and water use would drop by 49 billion gallons.

Storage

We estimated impacts of cold storage for the 64% of the US potato crop that goes into processing. USDA data revealed that 89% of the US potato crop was harvested in the fall (USDA NASS, 2014). Using USDA monthly sales data we estimated that 81% of the fall crop is stored (USDA AMS, n.d.). Research by Patterson (2013) provided information on chlorpropham (CIPC) application timing and costs from which we estimated savings of reduced sprout inhibitor applications due to the cold-storage trait.

Research by Sparks and Summers (1974) was the source of data for cold-storage savings in potato shrink and loss for each month of storage. We estimated that 1.2 billion pounds of potatoes would not be lost if all stored processed potatoes had the cold-storage trait. The reduced loss is the amount that could be grown on 28,000 acres. For those reduced plantings, pesticide application would decline by 910,000 acre-applications. CO_2 emissions would decline by 180 million pounds and water use would drop by 20 billion gallons.

Costs

We estimated the economic impact of all three traits on production costs for typical Eastern Idaho growers (Table 7). Operating costs per acre, excluding any changes in seed potato costs, could be expected to decline 12%. Due to higher marketable yields and less waste, operating costs per cwt would go down 27%.

Discussion

A fourth trait that Simplot developed for Innate potatoes is lower acrylamides. It is among the intangible attributes that we did not analyze because of the complicated market dynamics. Although there are differences among varieties regarding acrylamide content (Bethke & Bussan, 2013), there is not a market price premium for that attribute. If consumer tastes and preferences change, the low-acrylamide trait could have value in the future.

Another benefit that was not included in the analysis is a possible boost in potato yield and quality for the

Table 7. Estimated change in Eastern Idaho potato grower production costs.

Item	Percent	Amount	Amount
Marketable yield	-	-	415
Plant rangers rather than RB (%, cwt/ac)	7%	29	-
Bruise waste reduced (%, cwt/ac)	2%	7	-
Blight yield loss reduced (%, cwt/ac)	5%	21	-
Blight storage shrink reduced (%, cwt/ac)	1.7%	7	-
Cold storage loss reduced (%, cwt/ac)	6.1%	25	-
Total yield changes (%, cwt/ac)	21.6%	90	-
Adjusted yield (cwt/acre)	-	-	505
Costs of production	-	-	-
Operating costs ($/acre)	-	-	$1,976
Operating costs ($/cwt)	-	-	$4.76
Reduced cost: Fungicides ($/acre)	-	($87)	-
Reduced costs: Custom air spray ($/acre)	-	($21)	-
Reduced costs: CIPC ($/acre)	-	($127)	-
Total reduced costs ($/acre)	-	($235)	-
Adjusted operating costs ($/acre)	-	-	$1,741
Adjusted operating costs ($/cwt)	-	-	$3.45
Cost reduction ($/cwt)	-	-	$1.31
Cost reduction per cwt (%)	-	-	28%

Sources: Patterson (2013), Guenthner et al. (2001)

biotech version over the conventional version of the same variety. Although it is too early to predict commercial scale results, the improvements are plausible due to the power of line selection. For the Norkotah variety there is a history of yield and quality improvements due to line selection (Miller, Scheuring, Miller, & Fernandez, 1999; Whitworth, Hamm, & McIntosh, 2010). With the four traits of biotech potatoes that Simplot has introduced, perhaps line selection in the development process will enhance other traits as well.

Adoption of new varieties and changes in the mix of varieties planted was beyond the scope of this study. We estimated impacts for traits, not specific varieties. The approved Simplot varieties that have all three of the evaluated traits are Russet Burbank, Ranger Russet, and Atlantic. Within the fresh russet market, Russet Burbank has about 28% of the total share (Figure 1). Although popular among processors, Ranger Russet is not used by

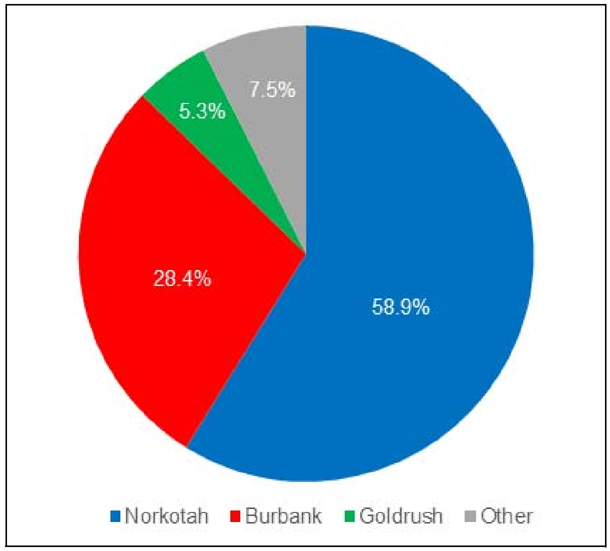

Figure 1. Variety shares of the US fresh russet market, 2013.

fresh packers. Some packers have tried Rangers but were disappointed in the high amount of bruising. Since Simplot's Ranger has bruise resistance, the biotech version of that variety could re-enter the fresh market. If it did, higher yields and better packout rates could provide additional economic benefits that were not counted in this study. Not included among the Innate varieties is Norkotah, which is the most popular fresh russet variety at nearly 60% of the total and is grown in all fresh russet states.

The economic analysis of this study involved estimates of potato production costs not incurred. Due to reduced shrink, loss, and waste, fewer acres of potatoes would need to be planted to produce the same total quantity. We did not account for the crops that growers would plant instead of potatoes. Since small grains is a common rotation crop for many potato growers, it is likely that some plantings would shift from potatoes to grain. For a typical grower in Eastern Idaho, the comparative 2013 operating costs of $1,976 per acre of potatoes (Patterson, 2013) and $408 per acre for spring wheat (Patterson & Marshall, 2013) gives a difference of $1,568 for each acre shifted. Using Field to Market fact sheets (2015a & 2015b) and the Patterson yields of 415 cwt/acre for potatoes and 115 bu/acre for wheat, CO_2 emissions would decrease 56% for each acre shifted from potatoes to wheat.

While this study estimated the value of several potato traits, the benefits depend on consumer acceptance of the potato products with those traits—Simplot's Innate potatoes. Some people question how acceptance now might differ from 2001 when Monsanto abandoned their biotech potato products. One difference is that consumers view Simplot's intragenic technology more favorably than the transgenic technology Monsanto used to transfer soil bacterium genetic material into potatoes. A second difference is that Simplot is on a market-chain link that is closer to the consumer. While Monsanto has been in the business of selling inputs to farmers, Simplot has been selling food products and better understands consumer preferences. A third difference is that Simplot, unlike Monsanto, has implemented an identity preservation program that limits distribution to licensed growers, packers, and processors. All handlers of Innate potatoes are trained in methods that reduce the risk of biotech potatoes being mixed with conventional potatoes.

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Acknowledgements

Support for this research was provided by Simplot Plant Sciences.