CONTEXT | GLOBAL DEVELOPMENT

Early Generation Seed Case Study

Idaho Potatoes

August 2018

Table of Contents

Idaho Potatoes Case Study

Appendix

CONTEXT | GLOBAL DEVELOPMENT

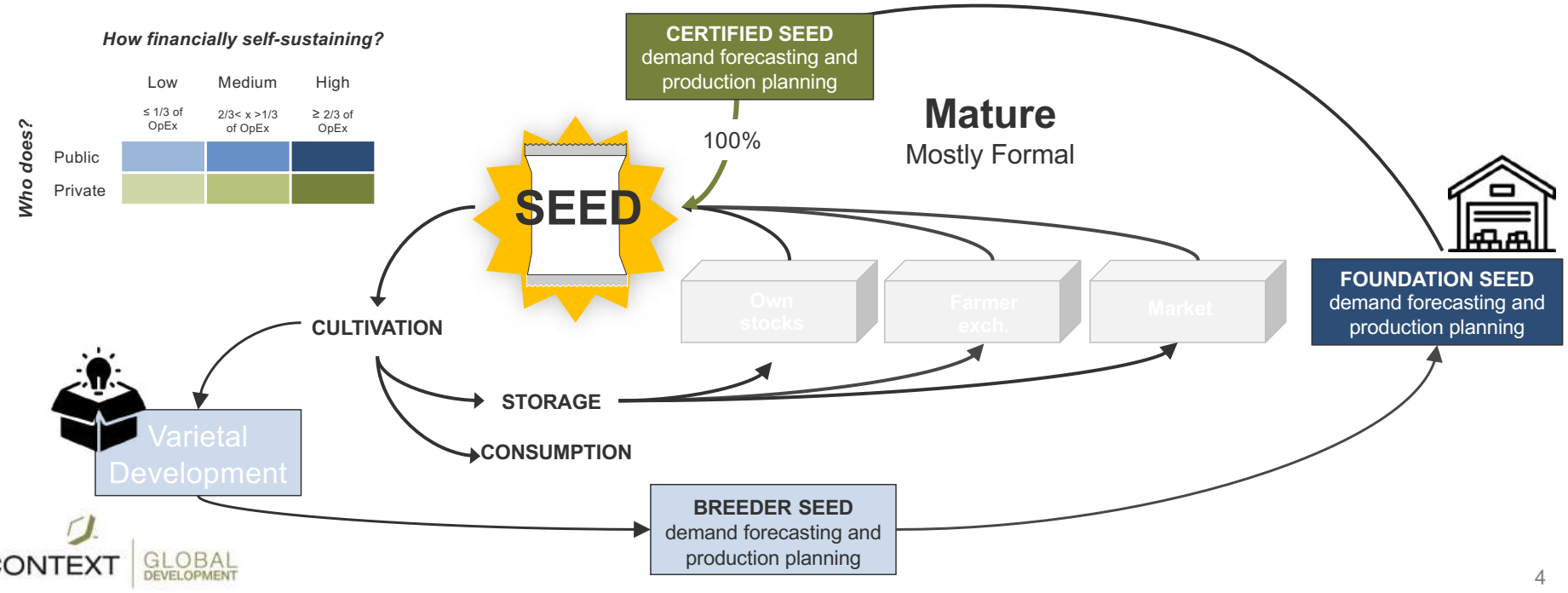
Executive Summary

CONTEXT | GLOBAL DEVELOPMENT

SEED SYSTEM STRUCTURE

Public Sector Funds Varietal Development and Private Sector Manages the Rest

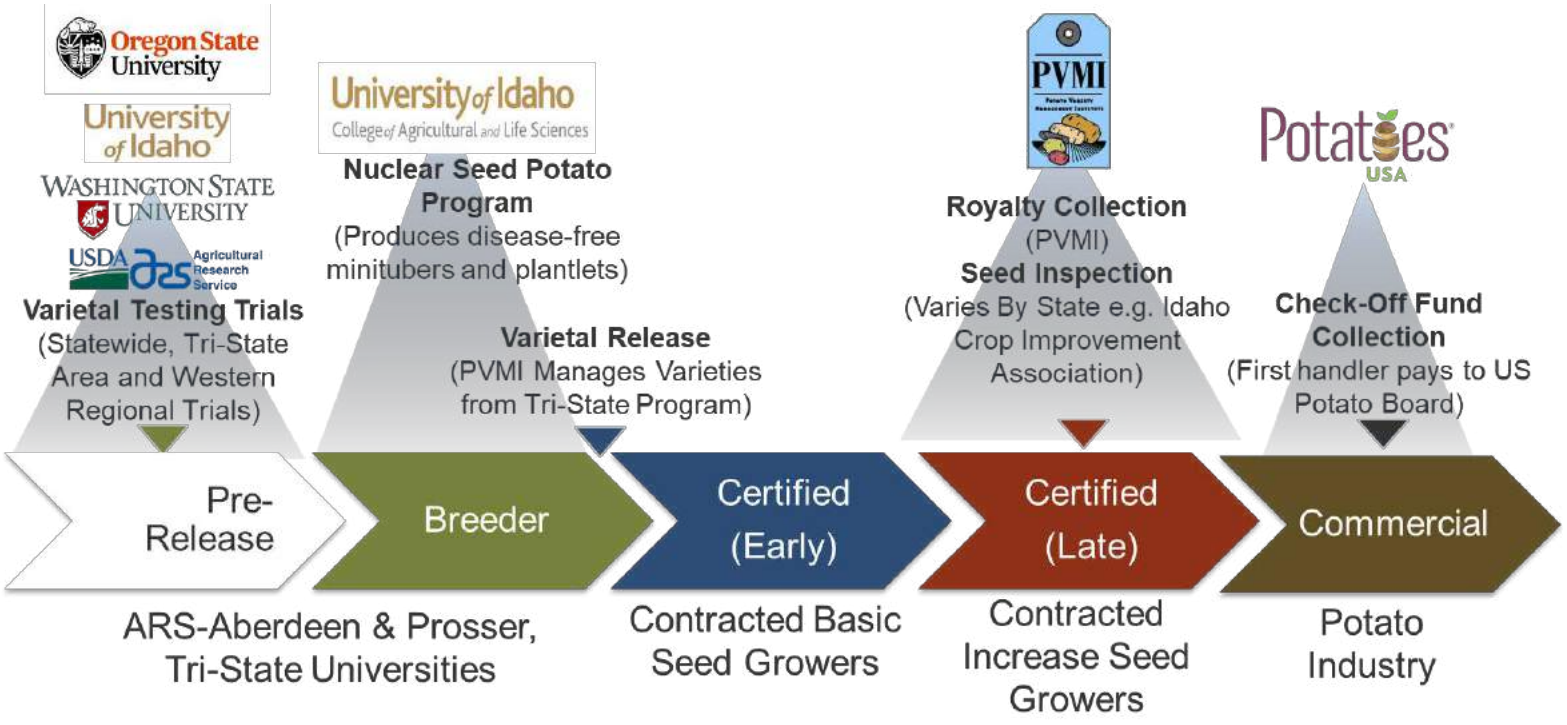
Germplasm/ Varieties → Breeder Seed → Foundation/ Basic Seed → Certified Seed/QDS → Distribution → Primary Production → Distribution/ Consumers



CONTEXT | GLOBAL DEVELOPMENT

SEED SYSTEM STAKEHOLDERS

Organizational Leadership by Value-Chain Step



CONTEXT | GLOBAL DEVELOPMENT

SEED FLOW

Early Generation Seed Deployment Model

	Breeder Seed	Foundation (Nuclear) Seed	Certified Seed	Commercialization
Who	**USDA-ARS** Aberdeen, ID	**Nuclear Seed Potato Program** University of Idaho (Moscow, ID)	**Independent Seed Growers**	**Independent Growers** Purchase seed from certified seed growers
Sector	Public	Public (but financially sustainable)	Private	Private
Input	80 lb. of Pre-Breeder Seed	800 lb. of Breeder Seed	8,000 lb. of mini-tuber, (200,000-250,000 Plantlets per year)	80,000 lb. Certified Mini-tuber Seed
Output	**800 lb. Breeder mini-tuber Seed** 	**8,000 lb. mini-tubers (Foundation Seed)** 	**80,000 lb. Certified mini-tubers** 	**49.5 billion pounds of Commercial Potatoes** 
Capital Sources	• State Funding • NIFA grants • Private company funding • Check off funds	• Nuclear seed sales cover all costs of nuclear seed production	• Certified seed sales • NOTE: State potato commissions collect assessments to fund state marketing and potato research	• Commercial seed sales • NOTE: potatoes USA collects an assessment to fund marketing activities for all U.S. potato growers

KEY SUCCESS FACTORS

Summary of EGS System Success Factors

FINANCIAL SUSTAINABILITY

Seed System is Self-Funded; Breeding Activities Supported by Multiple Funding Sources

- Public Sector Funds Tri-State Research
- Seed Multiplication Occurs on a Cost Recovery Basis Due to Grower Willingness (& Requirement) to Pay For Quality Seed
- PVMI Empowered by Growers to Collect Royalty and Licensing Fees on Tri-State released Varieties
- Independent 3rd Party Provides Service to the Value Chain That Ensures Prices Received Increase with Grower Costs

DEMAND PLANNING & OPERATIONS

Compulsory Certified Seed Market of Commercial Growers Who are Tightly-Linked to Seed Producers

- Communication Between Seed Growers and Downstream Users
- Nuclear Seed Supply Planning Encourages Seed Producers to Pre-Order and Be Reliable Buyers
- Seed Growers Anticipate Commercial Demand Through Deep Understanding of Customer Operations & Understanding of Market Dynamics Through Industry Connections
- Public Sector Structures Evaluations to Account for Private Sector Input on Breeding Targets
- Seed Growers are Highly Specialized and Grow Seed Potatoes in Isolated Areas to Reduce Contamination Risks

ENABLING ENVIRONMENT

Concentrated Group of Growers Supported By a Publicly Funded Breeding Program

- Farmer & Industry Trusted, and Supported Research Program
- Industry Involvement in Variety-Specific GAP Ensures Tri-State Varieties Realize Full Market Potential
- Close Proximity & Collaboration Among Stakeholders
- Industry Marketing Association Effectively Utilizes Tools and Lean Structure to Increase Farmer Demand for Tri-State Varieties
- Seed Quality Assurance Agency is Reputable and Reliably Fulfills its Mandate to Certify 100% of Seed
- Breeder-to-Breeder Collaborations Increase Access to Germplasm
- Grower Demand for Quality Seed Resulted in Seed Laws Requiring 100% Certification

KEY SUCCESS FACTORS

Financial Sustainability

Public Sector Funds Tri-State Research	Research and varietal development are funded by a variety of public sources including funds from the universities, USDA-ARS, and NIFA grants. The Aberdeen Research and Extension Center Superintendent is the only University of Idaho employee hard funded by the university; all other employees are funded through NIFA grants. USDA-ARS provides overhead funding for ARS employee salaries.
Seed Multiplication Occurs on a Cost Recovery Basis Due to Grower Willingness (& Requirement) to Pay For Quality Seed	Beyond varietal development, this system is mostly self-funded. Nuclear seed and certified seed are both produced on a cost-recovery basis due to downstream consumers willingness to pay for quality seed at each multiplication stage, but also due to the requirement that commercial growers purchase certified seed. In Idaho and many surrounding states, 100% of commercial potatoes grown must have been produced from certified seed. Growers at all phases of multiplication have the choice to look elsewhere for non Tri-State varieties, but more than 80% of certified seed growers in Idaho choose to pay for the quality of Tri-State varieties through PVMI, allowing for financial sustainability of NSPP and the certified seed growers.
PVMI Empowered by Growers to Collect Royalty and Licensing Fees on Tri-State released Varieties	PVMI also operates on a cost recovery basis from royalties and licensing fees collected on the Tri-State varieties. PVMI has exclusive rights to license Tri-State varieties and uses this income to fund its marketing, public relations, and administrative costs. Any funds brought in by PVMI beyond the budget necessary for funding these PVMI functions are directed back toward Tri-State breeding activities. One key to PVMI's financial success is that it is responsible for managing the dissemination of varieties in the US and internationally and can ensure that all royalties and licensing fees that should be brought back to the programs are collected, providing financial security.
Independent 3rd Party Provides Service to the Value Chain That Ensures Prices Received Increase with Grower Costs	The University of Idaho provides updated crop budgets every two years to inform crop producers, lenders, and processors of the changing costs and returns on cropping enterprises. These budgets originated as a service to growers to not only assist them in planning for changing future costs of production, but also to help provide leverage with processors when negotiating for higher compensation. As grower costs rose in the past, processors did not have visibility into these changes and were not adjusting grower payments. These crop budgets are available online for growers to access for no fee when negotiating changes in compensation.

CONTEXT | GLOBAL DEVELOPMENT

KEY SUCCESS FACTORS

Demand Planning and Operations

Communication Between Seed Growers and Downstream Users	Potato seed growers are connected to all downstream users, including commercial growers and processors, through multiple channels and based on long-standing relationships. Connections with and knowledge of industry needs and trends provides valuable planning information to seed growers.
Nuclear Seed Supply Planning Encourages Seed Producers to Pre-Order and Be Reliable Buyers	The Nuclear Seed Potato Program (NSPP) operates on a yearly production planning cycle to ensure that supply meets demand. Growers typically place orders in December to receive mini-tubers or plantlets by the next fall. The program does not plan for surplus demand and this encourages growers to plan well in advance of immediate needs. Informal agreements for picking up and paying for seed exist in place of binding contracts. Self-regulation in adhering to the informal agreements is made effective on the basis of grower reputation being dependent on following through on ordering commitments.
Seed Growers Anticipate Commercial Demand Through Deep Understanding of Customer Operations & Understanding of Market Dynamics Through Industry Connections	Seed growers lean on their experience to operate at optimal production capacities and are well trained on how to achieve certification standards through repeated interactions with Idaho Crop Improvement Association. The best seed growers operate on a four-year production planning cycle and do not plan for oversupply. It is extremely difficult to market surplus potatoes due to changes in fresh market and processing qualities once the potatoes are stored for extended periods. A seed grower coop has developed an alternative channel for the “big uglies” that cannot be sold into traditional channels, but growers do not rely on this channel’s availability when planning their supplies. Growers only supply varieties that their customers demand and are cautious to bring on new varieties that do not display sufficient requests.
Public Sector Structures Evaluations to Account for Private Sector Input on Breeding Targets	The public and private sectors collaborate to evaluate developmental lines for traits that increase the profitability of commercial potato production, especially related to fry processing characteristics. The public sector recognizes the value of considering early input from the private sector on field performance trials during the first three years of development to increase the efficiency of its resource allocation and improve the commercial adoption of new varieties. Private companies also recognize that providing feedback to the breeding program is pivotal to successful variety development and industry advancement and offer input willingly.
Seed Potatoes are Grown in Isolated Seed Management Areas To Reduce Contamination Risks	The majority of potato seed growers are seed growers exclusively and do not cross over into commercial production. They grow in specified Seed Management Areas away from commercial production farms to reduce the risk of contamination of their seed crops by pests and pathogens that can jeopardize seed certification. Any potatoes grown in Seed Management Areas is held to a higher standard due to certification rules than those grown in conventional areas and demand a higher grower price reflecting the quality advantages.

KEY SUCCESS FACTORS

Enabling Environment

Farmer & Industry Trusted & Supported Research Program	Potato seed and commercial growers trust the Tri-State Program to deliver improved, virus free varieties in their new releases. Certified seed growers have the option to buy varieties from public sources (other than the NSPP), but ~80% or more are willing to pay for the Tri-State varieties through PVMI due to perceived quality advantages. Industry, mainly driven by the quick serve fry market, also demands the improved Tri-State varieties due to their superior frying characteristics.
Industry Involvement in Variety-Specific GAP Ensures Tri-State Varieties Realize Full Market Potential	University of Idaho and the University of Washington provide growers with agronomic information on Tri-State varieties through management bulletins and presentations, but little extension activity is available for on-farm grower support. Industry representatives, with interest in receiving quality potatoes in desirable volumes, have stepped in to act as the go-to sources when growers have specific growing questions. The ability for large potato companies to access University of Idaho TC labs and industry testing of pre-released materials encourages a strong and lasting bond between industry and the university.
Close Proximity & Collaboration Among Stakeholders	Idaho, Washington, and Oregon consistently rank as the top potato producing states in the US. The close proximity of actors, including breeders and researchers at all three land grant universities and ARS, state seed certifiers, growers, and processors encourages the development of trust-based relationships and an ability to collaborate within the Tri-State area. At times when funding is tight at any one institution, the other institutions will step in and alleviate those pressures by reallocating funds for the overall advancement of the Tri-State program.
Industry Marketing Association Effectively Utilizes Tools and Lean Structure to Increase Farmer Demand for Tri-State Varieties	PVMI is a trusted resource for Tri-State potato variety marketing, public relations, collection of royalty and licensing fees, and general management of variety dissemination. PVMI is operated by two employees that report to a board of directors and operates as a fully funded non-profit. This financial sustainability is made possible through a conservative use of human resources, with the optimal capacity being able to perform all necessary functions related to marketing and administration. No extra grower money or time is spent on unnecessary personnel or functions. PVMI was initially funded by a $250,000 grant underlining the importance that growers and industry saw for this type of organization to exist.
Seed Quality Assurance Agency is Reputable and Reliably Fulfills its Mandate to Certify 100% of Seed	The Idaho Crop Improvement Association is the organization mandated to certify 100% of Idaho seed potatoes under the 1996 Idaho Seed Potato Law, with operations overseen by Idaho State University. ICIA is built on a reputation of transparency in certification practices and experienced agents and has been the duly authorized agent to administer and conduct Idaho seed certification since 1959. The program relies on certifying agents who have 10+ years of experience with the program to operate quality inspections and certifications. The director ensures that no conflicts of interest arise from long standing relationships between inspectors and growers by rotating inspectors so that the fields on a farm are not routinely inspected by the same inspectors.

KEY SUCCESS FACTORS

Enabling Environment (cont.)

Breeder-to-Breeder Collaborations Increase Access to Germplasm	Tri-State early stage breeding clones (pre-varieties) are initially grown in greenhouses from true potato seed, with only the largest tubers generated from the seedlings kept by ARS for further planting and evaluations in the next field year. To increase germplasm availability in the potato breeding industry, breeders throughout the US (Tri-state, ND, ME, TX, WI, CO) exchange the second and third largest tubers (without the hindrance of IP agreements) in order to facilitate the maintenance of genetic diversity within a breeding program and optimize the use of additional seedling tubers generated by each cooperating breeding program. These shared seedling tubers would otherwise be thrown away.
Grower Demand for Quality Seed Resulted in Seed Laws Requiring 100% Certification	The Idaho Seed Potato Law was enacted by the Idaho State Legislature in 1996 largely in response to a nation-wide task force that recommended mandatory seed laws as a way to combat bacterial ring rot outbreaks. The law mandates that 100% of commercial potatoes grown in Idaho must be planted as certified seed, with traceable inspection metrics available throughout the certification process. The University of Idaho is the seed certifying authority designated by the state of Idaho and oversees Idaho Crop Improvement's seed inspection and certification activities. This seed law is one of the first cases where certification was made mandatory at the request of growers to solve an industry threat.

PAIN POINTS

EGS Seed System Pain Points

Financial Sustainability

- Heavy reliance on grant funding and federal and state funding leads to uncertainties each year on how much each program will receive for operations

Demand Planning & Operations

- Growers believe that it is difficult to scale up a seed growing operation because quality management practices are not scalable
- The more varieties or acres a grower produces, the greater risk they take of whole farm disease issues
- Human error in virus testing and errors inherent with small sample sizes at the Hawaii winter location can lead to perceptions of false certification testing results
- Correct storage methods and alternative channels for oversupply keep seed growers operating on a supply-only-to-demand basis

Enabling Environment

- NSPP lacks clear and binding formal grower contracts on seed orders presenting considerable financial risk
- ICIA's governance structure makes for long lead times when changes need to be made in the certification process

CONTEXT | GLOBAL DEVELOPMENT

SEED SYSTEM EVOLUTION

Idaho Potato EGS System

	1900-1949	1950-1999	2000-Present
FINANCIAL Levies | Royalties	**1937-** Growers payed the ID Fruit and Vegetable Advertising Commission 1 cent/cwt for promotion of industries **1939-** Checkoff reduced to .05 cents/cwt (seed potatoes exempt). Initially reduced advertising budget, but increased potato production actually increased the overall budget in the long run **1951-** Idaho commercial potato farmers received $1/cwt more for potatoes than farmers in other regions due to demand created from marketing		**2006-** Tri-State Commissions contribute $225k to PVMI Initiation; PVMI business plan creation assisted through federal funding **2010-** First Year that university breeding programs receive royalties from PVMI **Continued financial support** from PVMI through royalty collection
DEMAND PLANNING/OPERATIONS Technology | Systems	**1872-** Original Burbank variety developed- beginning of Idaho potato industry **1940-** Widespread sprinkler irrigation begins in Idaho potato industry, including technologies that allow for irrigation of fields on rolling hills, leading to increased production **1940-** Idaho Crop Improvement Association est. by Idaho seed growers **1940-** Idaho Seed Growers Association joined ICIA	**1983-** Nuclear Seed Potato Program begins at University of Idaho, when a focus on clean TC was beginning to gain importance. Leadership remained the same until 2016. **1993-** Idaho Pure Seed law written requiring all Idaho potato seed be certified **1995-1996-** Seed law implemented requiring all Idaho potato seed be certified	**2011-** Oregon State University begins using NSPP to clean up OSU breeding clones **2013-** ICIA moved winter testing location from CA to HI **2018-** NSPP plans to expand greenhouse space and double production capabilities **Continued** improvements in molecular techniques to improve seed quality instead of relying solely on visual inspections
ENABLING ENVIRONMENT Policies | Stakeholders	**1894-** The Cary Act opened up one million acres of desert land for irrigated agricultural production; 60% of this land is in Idaho **1914-** University of Idaho Research Station at Aberdeen established (potato breeding was completed in Maryland beginning in 1930s) **1926-** Rogers Brothers Seed Company completes first dehydration of Idaho potatoes for food products; credited as beginning of processing industry **1928-** ID Grower Shippers Assn. formed **1937-** The Idaho Fruit and Vegetable Advertising Commission est. to promote potatoes, apples, onions, and prunes **1939-** Idaho Pure Seed Law inducted (Title 22) including rules on seed potato packing and tagging **1939-** Idaho Fruit and Vegetable Advertising Commission evolved into Idaho Advertising Commission est. (later the Idaho Potato Commission) **1949-** University of Idaho potato breeding program established by USDA -ARS	**1951-** Idaho Pure Seed Law updated (Title 22) **1955-** Patent filed for 'GROWN in Idaho' label **1959-** IPC worked with packers to identify 'Packed in Idaho' designation **1959-** Seed and Plant Certification Act designated the Univ. of ID to assign an agent to conduct seed certification; ICIA was appointed **1967-** JR Simplot begins working with Ray Kroc to supply frozen French fries to McDonald's **1984-** USDA joined existing potato breeding program with the ID, WA, OR potato industries; start of the Tri-State Potato Breeding Program. **1989-** Idaho Pure Seed Law updated (Title 22)	**2004-** Tri-State potato commissions warrant Income Potential Feasibility Studies for royalty collections on potential Tri-State varieties **2005-** PVMI incorporated as non-profit, initiated by state potato commissions

SEED SYSTEM EVOLUTION

Idaho Potato EGS System Key Takeaways

- Focus on marketing led to the creation of Idaho's powerhouse potato market. The Idaho Fruit and Vegetable Advertising Commission began advertising Idaho potatoes in national magazines and was able to create a price premium for Idaho commercial potato growers of $1/cwt more than was received by other states. The evolution of the Commission into the Idaho Potato Commission (IPC; focused solely on potato promotion) in the 1950s allowed for more branding of products and increased consumer demand for Idaho-grown potatoes. Now, IPC manages the Idaho potato branding and marketing, but is also a voice for the industry when consumption is low domestically and internationally. This story of evolution of the marketing program is key to the success of the Idaho potato industry's success.

- NSPP was formed when the realization of the value of quality tissue culture was starting to become mainstream, similar to how hydroponics is now starting to become mainstream. Demand for clean material by growers was rising, and the university realized that tissue culture was the answer to meet the demand. Jenny Durrin notes that there were a lot of regulations that came into play prior to NSPP's creation and that certification became a necessity.

- The Tri-State Potato Breeding Program evolved from the existing USDA potato breeding program in Aberdeen. Potato breeding had been done previously by separate states and the USDA decided that by joining the forces of the three potato growing states and their research divisions, not only would the Aberdeen program reach greater success, but the whole industry would benefit from higher adoption of new varieties and elimination of redundancies across the programs.

- Irrigation of farmland played a large role in the evolution of the Idaho potato industry. Sprinklers allowed for irrigation that could be moved between fields and reduced irrigation runoff. It also made it possible to farm on rolling hills instead of just flat land. The Cary Act of 1894 contributed to the increased levels of irrigation by making one million acres of federal land available to states if they agreed to irrigate them for agricultural use. In Idaho, this allowed farmland that was previously only suited as range for cattle and sheep to be transitioned in to family potato farms.

- The state continually updates and revises seed laws that allows for improvements to be made that benefit farmers and the industry.

TECHNOLOGY SPOTLIGHT

NSPP Ebb-and-Flow System

	Previous System	New System	New System Impacts
Method	Conventional 20'x100' greenhouse with time-released fertilizer and irrigation; mini-tubers planted in gallon pots	Ebb-and-Flow System	
Crops per Year	3	3, potential for 5 crops/year	Potential increase in crops/year is dependent on NSPP ability to secure additional greenhouse space
FTE Required for Production	3	3	No change in FTE required
Avg. Productivity	0.4lb of mini-tubers/pot	0.64lb of mini-tubers/pot	**Yield increases average 60%,** but one trial saw a 150% increase in yield (1 lb mini-tubers/pot)
Total Yearly Production	~5,000 lbs	~8,000 lbs	Total yearly production increases mirror productivity **increases of 60%**
Cost per Unit	$29.10	$19.06	**35% decrease in cost/unit,** after accounting for increases in yield and decreases in growing time
Profit	$3.90/lb	$13.94/lb	**257% increase in profit,** after accounting for increases in yield and decreases in growing time
Income per Year (at $33/lb mini-tuber)	~$165,000	~$264,000	Total yearly income increases mirror productivity **increases of 60%**

THE BUSINESS CASE:

Major Yield increases and Decreased in Growing Time

- 50-60% increase in mini-tuber yield per pot
- 40% decrease in plant growing time- could do 5 crops per year, but constrained by the time needed in between crops for additional plantings
- No longer need to rely on time released fertilizer and irrigation; this method means giving up consistency in size, but helps eliminate dormancy issues
- Total cost is higher for ebb-and-flow, but increase in yield and decrease in time results in a more cost effective system

Ebb-and-Flow System Evolution

- The NSPP program runs completely off seed sales. The initial investment in the new system was made by the NSPP program pulling from it's own funds
- Prelim tests were run with two trays and increased following successes in productivity
- Now, NSPP is requesting funding from the college to convert a larger greenhouse to all ebb-and-flow systems; the college will provide 20 4'x8' tables & additional cold room storage and reservoirs; NSPP is responsible for all production costs (e.g. pots, growing media)

Source: Jenny Durrin, University of Idaho

Market Dynamics

MARKET DYNAMICS

The Tri-State Area Accounts for More than 60% of U.S. Potato Production

The U.S. Ranked 5th Globally for Total Potato Production in 2016

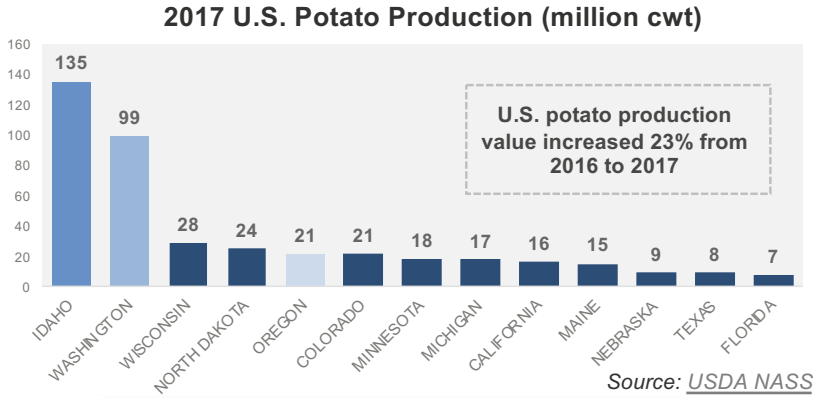
	#Country	2016 Production Total (tons)	% of Total
1	China (incl. Taiwan)	109,034,662	27%
2	India	48,147,000	12%
3	Russia	34,218,577	8%
4	Ukraine	23,925,319	6%
5	United States	21,990,045	5%
6	Germany	11,849,310	3%
7	Bangladesh	10,421,509	3%
8	Poland	9,759,690	2%
9	France	7,518,148	2%
10	Netherlands	7,187,772	2%
11	Others	118,597,847	29%
	Total	402,649,878	100%

Source: FAOSTAT

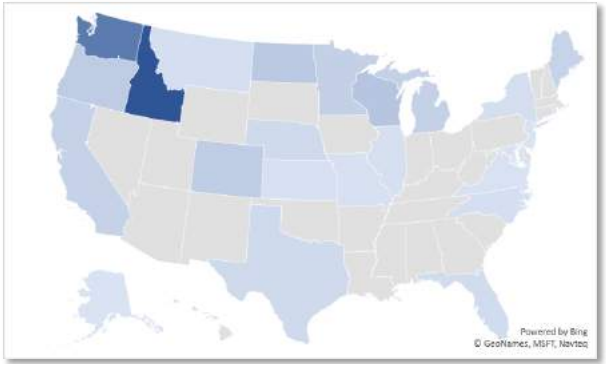
CONTEXT | GLOBAL DEVELOPMENT

Source: Idaho State Journal

Idaho Consistently Ranks as #1 for U.S. Potato Production



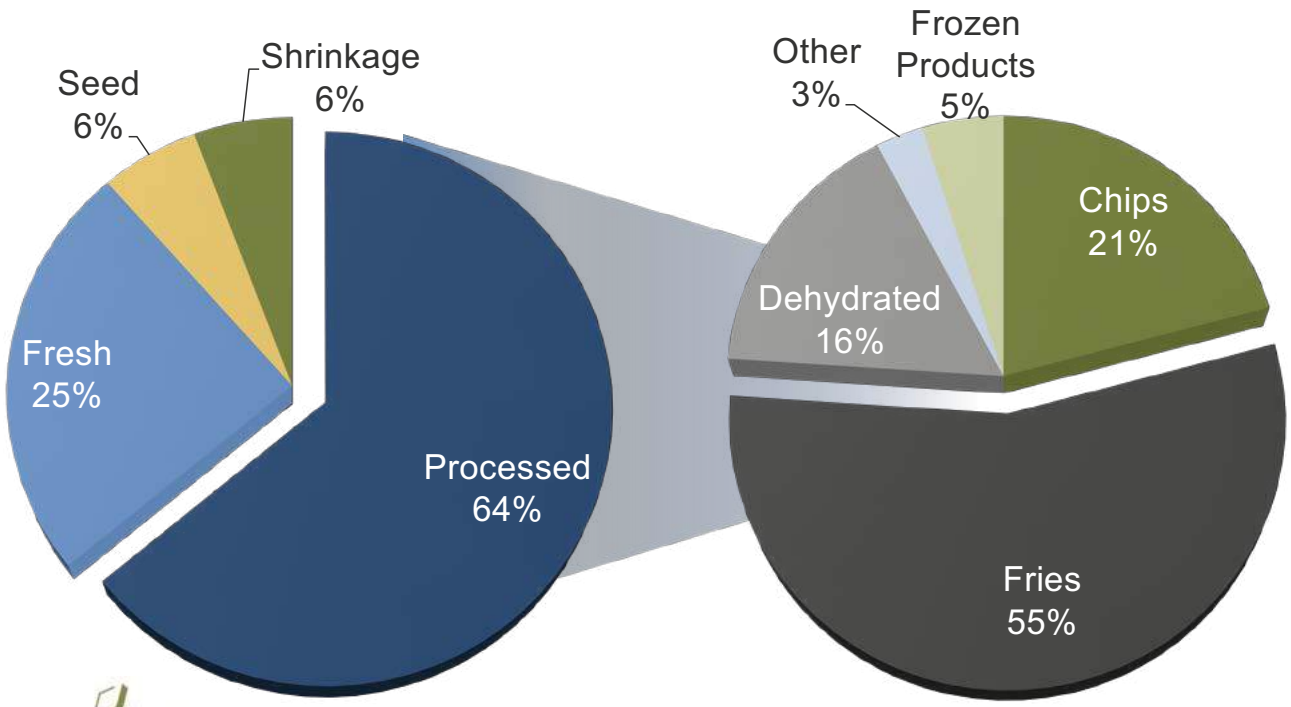
Source: USDA NASS



MARKET DYNAMICS

The Majority of U.S. Potato Production Goes to the Processed Market, With the Fry Industry As the Leading Processed Market

2017 U.S. Major Potato Market Segments & Subsegments



CONTEXT | GLOBAL DEVELOPMENT

Source: USDA-NASS: Potatoes 2016 Summary, (Sept. 2017)- Adapted from University of Idaho and USDA-ARS Presentations

The **strength of the fry market** is a **major driver** for the Tri-State Potato Program's variety development planning

Four out of **McDonald's** seven **"gold standard" varieties** are Tri-State developed varieties

Commercial potato growers **historically demand varieties** that can be sold into the dominant processed market

The Tri-State Program has **delivered value** by providing varieties with market-demanded characteristics

MARKET DYNAMICS

Alternative Potato Health Benefits are Touted Throughout the Industry Hedge Against Consumer Preference Shifts

As a Demand-Driving Strategy, Entities from the Tri-State Potato Breeding Program to the Idaho Potato Council are Touting Lesser-Known Potato Health Benefit Information:

Food Energy per Acre:

- 75% more than wheat | 58% more than rice

Vitamin C:

- 45% of required daily value (for a medium-sized potato)

Protein:

- Approx. 50% more protein than wheat | Approx. 80% more protein than rice
- Good balance of amino acids
- Biological value of potato protein = 90-100 (chicken egg standard is 100)

Phytonutrients/Anti-Oxidant Compounds

- Polyphenols | Flavonoids | Carotenoids

CONTEXT | GLOBAL DEVELOPMENT

Source: National Potato Council- Adapted from University of Idaho and USDA-ARS Presentations

Leadership

LEADERSHIP

Idaho Potato Industry is Founded on Close Collaboration Between the University of Idaho and USDA-ARS in Variety Development

VARIETAL DEVELOPMENT & SEED DEPLOYMENT

Varietal Development

Varietal development for the Idaho EGS system is conducted through a close collaboration between the Tri-State Potato Breeding Program, which includes three universities (Idaho, Washington, and Oregon) and USDA-ARS researchers. USDA-ARS is the entity responsible for the breeding activities for the EGS system.

Seed Multiplication

Breeder seed production (seedling tubers) is managed by the USDA-ARS in Aberdeen, ID. Breeder seed multiplication is managed by the University of Idaho Nuclear Seed Potato Program in Moscow, ID, which provides foundation seed (nuclear seed) to ~30 early-stage certified seed growers.

Certified Seed Production

Certified seed production is performed by ~65 certified seed producers, which are further split into early-stage certified seed growers that generally do greenhouse increases and late-stage certified seed growers who manage in-field increases from the bulked-up early certified seed. Certified seed growers are often contracted by commercial growers for seed production.

FARMER PRODUCTION, MARKETING, AND KEY DEMAND SEGMENTS

Farm Production

In 2016, the U.S. ranked 5th globally for potato production. Idaho contributes more than one-third of the U.S. potato production each year on about 320,000 acres. Of this production, about 6% is produced for certified seed. The potato industry contributes about $4 billion to Idaho's economy and provides more than 30,000 jobs.

Industry Advocacy

A main function of the Potato Variety Management Institute (PVMI) is managing the marketing and promotion of Tri-State varieties to potato growers in the U.S. and internationally; its activities are fully funded through royalty collections. Potato commissions in Idaho, Washington, and Oregon each exist to advocate for their individual potato industry growth and for their growers' interests. The U.S. National Potato Council and Potatoes USA performs marketing and advocacy activities for the entire U.S. potato industry.

Demand Segments

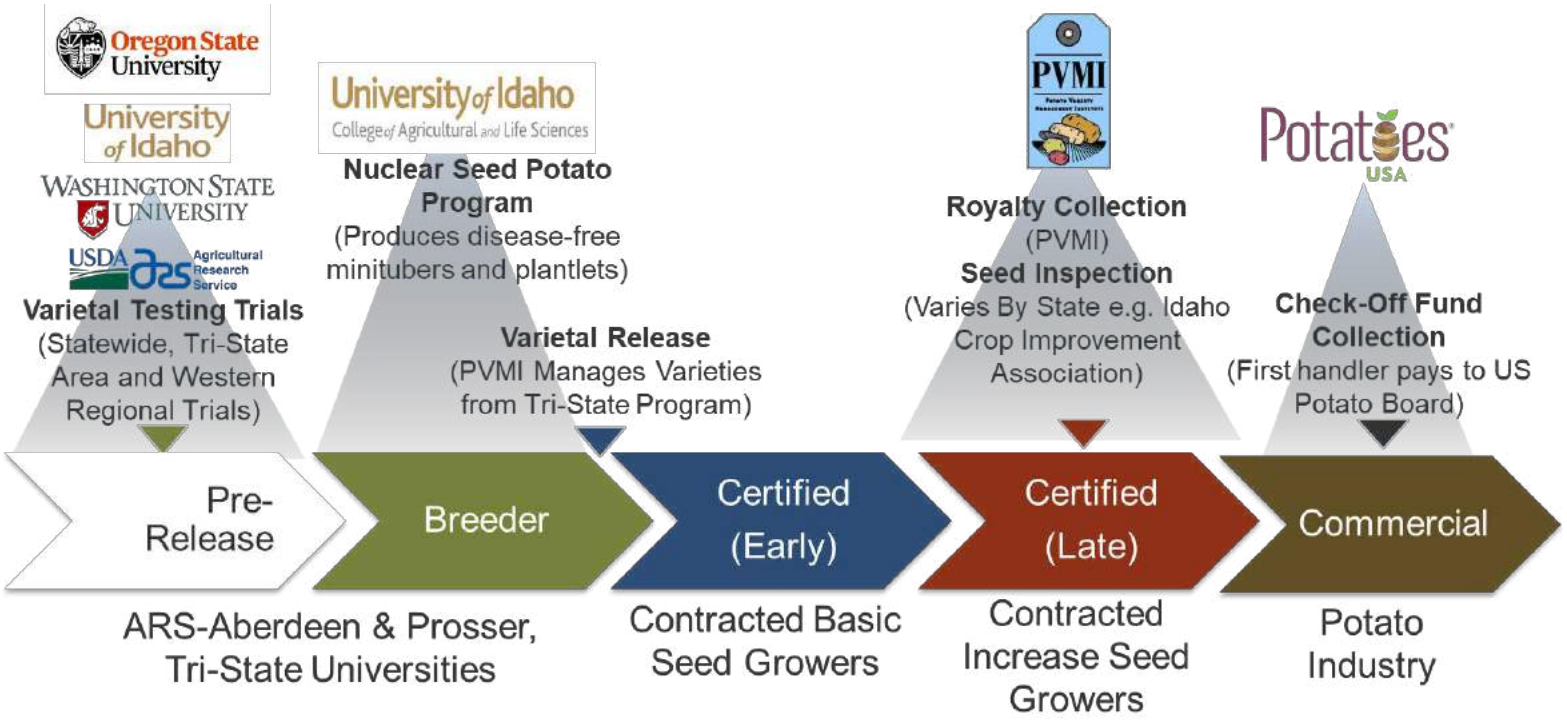
The U.S. potato industry is dominated by the processing sector and specifically by the quick-serve restaurant fry industry. This industry drives the majority of demand planning decisions in the system. Other main demand segments include fresh-pack for table consumption, chip potatoes and an emerging market in specialty varieties (e.g. purple-flesh potatoes).

ENABLING ENVIRONMENTSTAKEHOLDERS

Tri-State Potato Breeding Program | PVMI | Idaho Crop Improvement Association | Idaho Potato Commission | Potatoes USA

LEADERSHIP

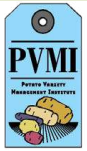
Organizational Leadership by Value-Chain Step



CONTEXT | GLOBAL DEVELOPMENT

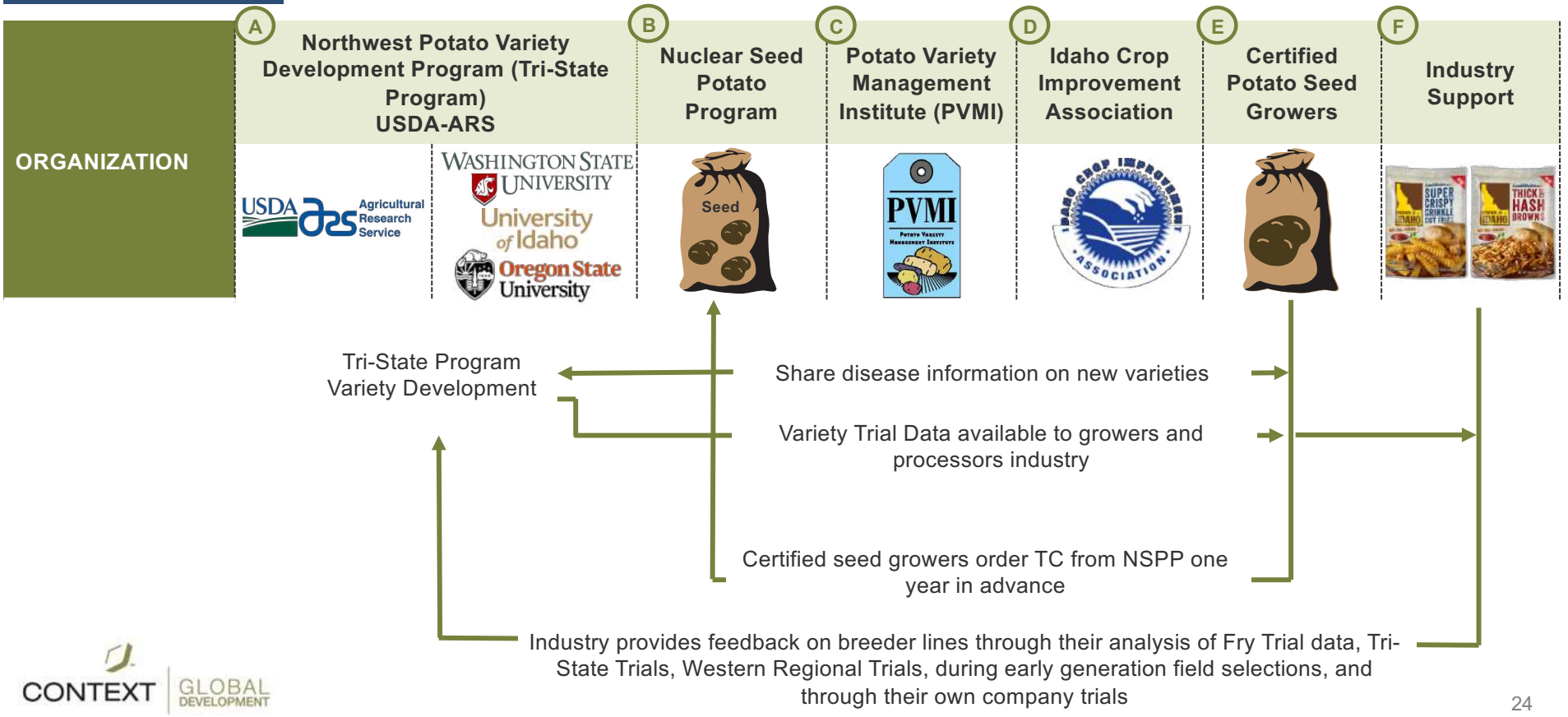
LEADERSHIP

Organizational Value Chain Leadership Summary

ORGANIZATION	A Northwest Potato Variety Development Program (Tri-State Program) USDA-ARS		B Nuclear Seed Potato Program	C Potato Variety Management Institute (PVMI)	D Idaho Crop Improvement Association	E Certified Potato Seed Growers	F Industry Support
	USDA Agricultural Research Service	Washington State University; University of Idaho; Oregon State University					
VALUE CHAIN ROLE	• Varietal Development • Seedling Tuber Development • Early Field Trials • Disease Screening • Breeder Seed Maintenance	• Conduct Advanced Trials • Develop New Variety Management Profiles	• Nuclear seed production & sale • Virus clean up • Germplasm maintenance	• Varietal licensing • Royalty collection • Tri-State variety marketing and public relations	• Field, greenhouse, and shipping point inspections • Seed certification	• Feedback for varietal development • Potato Seed Production	• Input on varietal development and industry preferences
MAJOR FUNDING SOURCES	• Federal Funding • Extramural Grants	• State Funding • NIFA grants • Private company funding • Check off funds to potato Commissions relayed to support research	• Mini-tuber and plantlet sales	• Royalties and licensing fees from Tri-State varieties	• Certification fees • Lab testing fees	• Sales of certified seed	• Sales of commercial potatoes
FINANCIAL SUSTAINABILITY	SUBSIDIZED BY THE PUBLIC & PRIVATE SECTOR		FINANCIALLY SUSTAINABLE	FINANCIALLY SUSTAINABLE	FINANCIALLY SUSTAINABLE	FINANCIALLY SUSTAINABLE	FINANCIALLY SUSTAINABLE

LEADERSHIP

Frequent Communication Between Value Chain Actors Supports Product Development & Varietal Adoption



CONTEXT GLOBAL DEVELOPMENT

LEADERSHIP

Northwest (Tri-State) Potato Variety Development Program

A

Created in 1985 for breeding, development, and release of new potato varieties for Idaho, Oregon, and Washington

Successful collaboration with 51 released varieties through PVMI

Five of these varieties are among the top 10 most widely grown in US

Aberdeen, ID Spotlight

The research center at Aberdeen houses both USDA-ARS and University of Idaho researchers with defined roles:

1. Potato Breeding
- Generates new potato hybrids
- Produces seedling tubers-1st field generation
- Field selection with industry/researchers
- Early replicated field trial evaluations
- Retain and advance or discard breeding clones

2. Plant Pathology
- Screening for disease resistance
- Maintenance of virus-free breeder seed

1. Conducts advanced trials

2. Develops management profiles of promising breeding clones
- Includes considerations on nutrient & water management and post-harvest storage of tubers

4. Conducts biochemical analyses

Promising breeding clones from Aberdeen and Oregon/Washington are released as new Tri-State potato varieties

LEADERSHIP

Nuclear Seed Potato Program

B

The U of I Seed Potato Germplasm Program in the College of Agricultural and Life Sciences works to establish, maintain and distribute disease free germplasm and mini-tubers for domestic and international seed potato growers and researchers.

Virus Clean-Up

Plantlet Production

Mini-Tuber Production

Germplasm Maintenance & Variety Integrity

NSPP is Financially Sustainable:

Sales of mini-tubers and plantlets to certified seed growers are the sole funding source of NSPP and cover all costs of operations

Total Income per Year: ~$360,000

NSPP is the **only source of all cleaned PVMI varieties** for certified seed production

Four Year Round Greenhouse Employees: Two FTE, Two HTE, 10 Student Employees

NSPP has a Far Reach:

Mini-tubers and plantlets are shipped throughout the US and internationally:
Canada | Netherlands | Germany | United Kingdom
South Korea | Japan | Australia | China | Jamaica | Peru

60% Of U.S. potatoes can be traced back to NSPP (pathogen eradication & plantlet and mini-tuber sales)

90% of potatoes in Idaho can be traced back to NSPP

CONTEXT | GLOBAL DEVELOPMENT

LEADERSHIP

Potato Variety Management Institute

C

2000: Universities began protecting newly released cultivars

2004: Potato commissions order income feasibility study on protected cultivars

2005: PVMI incorporated as a non-profit organization

2006: State commissions contribute $225k to initiate PVMI; Business plan created

Current: Administers Tri-State varieties and manages global marketing efforts

Promote and administer the new Tri-State potato varieties to maximize their success and return revenues to support the Breeding and Research Program and benefit potato growers of Idaho, Oregon and Washington.

CONTEXT | GLOBAL DEVELOPMENT

PVMI's main roles include:

Administration:

- Monitors PVMI seed growers
- Royalty and licensing fee collection
- Controls PVMI variety distribution
- Reports variety reports to board members

Marketing & Public Relations:

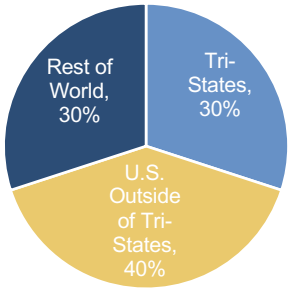
- Central contact point for PVMI varieties & growers
- Attends industry events
- Facilitates communication between industry and researchers
- Distributes marketing materials and press releases on new varieties

Nine-member board oversees two PVMI employees

PVMI is Financially Sustainable:

Royalties and licensing fees **fund 100% of PVMI's operations** and are collected from seed growers segmented by their growing location

PVMI's income is split between several streams of collections:



Any income collected beyond PVMI's operational budget is **directed back toward the Tri-State Program** for continued research efforts

LEADERSHIP

Idaho Crop Improvement Association

D

The Idaho Crop Improvement Association, Inc. was organized in 1940 by the certified seed growers of the State. The Idaho Seed Potato Growers Association voted to join the Idaho Crop Improvement Association, Inc. in 1942.

100% of Potato Seed Sold for Commercial Use in Idaho Must Be Certified Through ICIA

Governed by **10-person board of directors** & advisory committees for each commodity group

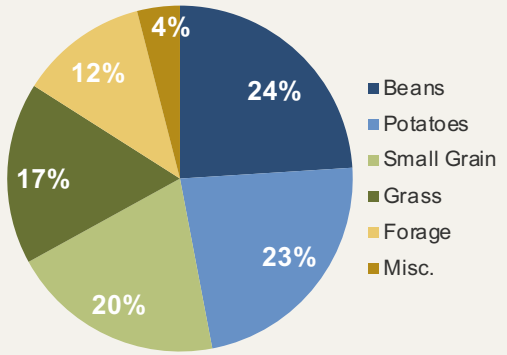
Twelve seed potato inspectors cover the **Idaho inspections;** many of these are school teachers who have been **inspecting** for 20-30 years

University of Idaho is the state's main seed certification agency and oversees ICIA's certification activities

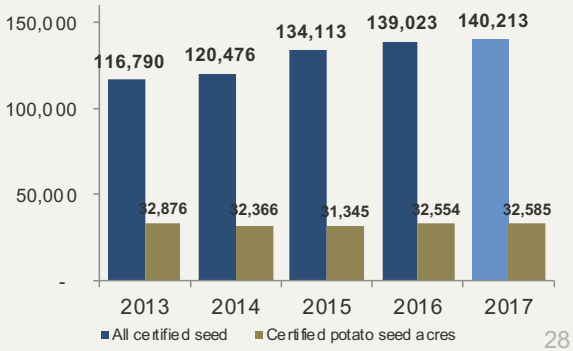
Authority from:
Idaho Code 22-15 and IDAPA 08.05.01

ICIA seed certifiers **reject ~1-2%** of seed lots annually, as growers are very familiar with the strict certification guidelines that they must meet

ICIA Crop Distribution



Idaho Certified Acres Accepted



CONTEXT | GLOBAL DEVELOPMENT

Research & Varietal Development

RESEARCH & VARIETAL DEVELOPMENT

Stage Gate Process – Breeding to Seed Deployment

10-to 15-year breeding process from cross to release:

	Breeding Phase	Varietal Testing Stage	Details	Location of Phase
Year 1-2	**Crossing** **2 Generations** **Cross to produce true seed** **True seed to seedling tubers**	**Generate breeding lines**	Crosses with 150 – 175 parental lines Harvest 160,000 – 175,000 seedling tubers, select on tuber size (Small tubers sent to other breeders in germplasm exchange)	**USDA-ARS Aberdeen and Oregon State University**
Year 3-7	**Field Selections**	**Single Hill Plots** (Year 3) **12-Hill Plots** (Year 4) **Replicated Trials** (Year 5-7)	YR 3: 105,000 lines in single hill plots YR 4: 2-3,000 lines in 12-hill plots YR 5: 500 – 900 lines, 20 hills x 2 reps (yield, specific gravity, processing attributes, disease resistance)	**YR 3-4: Aberdeen** **YR 5: Swan Valley, ID** **YR 6-7: Tetonia**
Year 8-12	**Continual selection** **Seed increases** (Breeder to Foundation) See next slide for details **Yield & Regional Trials**	**Statewide Yield Trials**	Statewide Trials are Replicated Trials that evaluate each state's new lines for targeted traits of interest	**Idaho & Oregon 3-4 locations**
		Tri-State Yield Trials (1-2 years)	All three universities test the same lines. WSU tests for post-harvest. Only Russets and specialty selections are made (no chippers).	**Tri-State universities**
		Regional Yield Trials	Occur for three years prior to release. Russets evaluated on early and late harvest management. All types of potatoes considered (includes chippers).	**WA, OR, ID, CA, CO, TX**
		Multiplication & Clean Up	One year process for clean up and multiplication. TC testing usually occurs post-Tri-State Trials.	**University of Idaho Nuclear Seed Potato Program**
Year 12-15	**Foundation Seed & Certified Seed Available to Certified Seed Companies and Growers**			

National Fry Processor Trials: A Special Case of Industry Involvement

All breeding programs submit potato processing breeding clones for industry consideration on processing characteristics

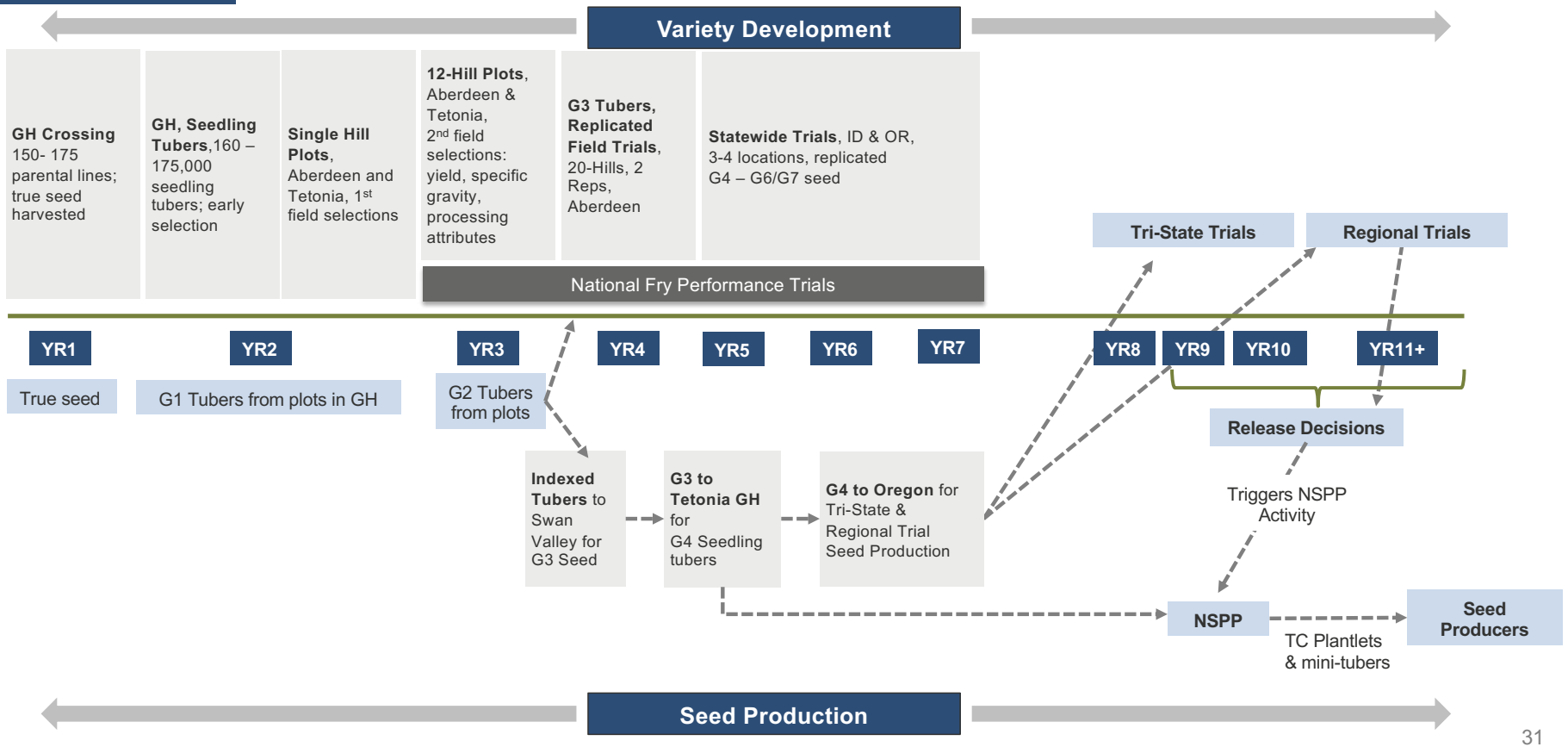
Six sites of the NFPT (WA, ID, ND, WI, ME, OR) give data on each of the new varieties, especially **related to sensory information for processors**

Funded by USA Potatoes and lead processing companies

Source: Conversations with Tri-State Potato Breeding Program Leaders; Tri-State Potato Breeding Program Presentations

RESEARCH & VARIETAL DEVELOPMENT

Variety Development and See Multiplication Schematic



RESEARCH & VARIETAL DEVELOPMENT

Multiple Trials are Key to Developing New Tri-State Varieties

Data collected from trials throughout the selection process include fresh pack potential, processing characteristics (including frying), specific gravity, nutritional content, and post-harvest characteristics

12 Hill Field Selections

Lab Testing for Processing Characteristics

Early Testing for Processing Characteristics in Statewide Trials

ACCEPTABLE FRYING AND CHIPPING RESULTS	UNACCEPTABLE FRYING AND CHIPPING RESULTS
	
	

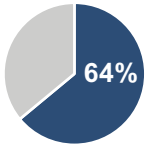
CONTEXT | GLOBAL DEVELOPMENT

Source: Tri-State Potato Breeding Program Presentations

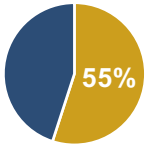
The National Fry Processing Trial is a Public Private Partnership Solving Real World Issues

"The National Fry Processing Trial (NFPT) is a multi-year and multi-location national effort that aims at identifying new potato breeding lines with low acrylamide forming potential while maintaining or exceeding the outstanding agronomic quality and consumer acceptance found in current varieties" –PVMI Progress Bulletin

NFPT Originated to Meet Fry Industry Needs:



Of U.S. Potato Production is Used for Processing



Of U.S. Processed Potatoes Are Used for Frying

Ranger russet is the only variety in 50 years to become commercially successful **outside of the French fry industry**

National French Fry Processing Trial 2011 Acrylamide Results

	November 22, 2011				February 2, 2012				
Clone/Variety	ID Mean	ND Mean	WA Mean	3 Loc. Mean	ID Mean	ND Mean	WA Mean	3 Loc. Mean	Rnk
W8152-1rus	125	143	70	113	138	123	165	142	1
AC99375-1RU	198	88	75	120	168	120	193	160	2
W9604-1rus	240	193	118	183	203	165	158	175	3
W8743-1rus	135	210	78	141	145	278	150	191	4
AF3001-6	258	168	105	177	275	158	143	192	5
ND060735-4Russ	273	145	195	204	278	253	175	235	6
ND059694B-20Russ	225	248	263	245	273	245	258	258	7
W6360-1rus	218	300	108	208	273	320	243	278	8
Alturas	398	473	383	418	1393	1028	1188	1203	79
Burbank	1388	723	475	862	1550	878	1243	1223	80
Highland Russet	615	710	570	632	1205	1028	1698	1310	81
AVE	385	418	262	355	636	638	511	595	

* Selection procedures need to be implemented to select for French Fry QSR traits

To date, the NFPT has evaluated **180+ new breeding lines**

Six NFPT locations report data: Idaho, Maine, North Dakota, Oregon, Washington, and Wisconsin

Tuber asparagine, sugar content, and acrylamide in fries after 1, 4, and 8 months of storage are evaluated in each line

Each year, selected clones are **processed into fries** at JR Simplot in Caldwell, ID and McCain Foods in New Brunswick, Canada where **fries are evaluated** using quick service restaurant (QSR) specifications for their consumer attributes

$250,000 budget **is fully supported** by the **Potatoes USA** and **industry partners** (including large potato processors and state potato commissions)

Source: National Coordinated Agricultural Project

RESEARCH & VARIETAL DEVELOPMENT

Seed Multiplication Timeline

6-year process from Breeder Seed to Commercial Seed:

This timeframe is for an average variety. It may differ depending on the variety profiled.

	Multiplication Phase
Year 10	Multiplication and TC Clean Up at NSPP
Year 11	Early Certified Seed Production (Foundation Seed)
Year 12-14	Late Certified Seed Production (G1-G3)
Year 15	Commercial Potato Production and Distribution

Breeder Seed to Foundation Seed Process:

NSPP is responsible for the clean up of tissue culture, breeder seed maintenance, and nuclear seed production

Certified seed producers buy plantlets or mini-tubers from NSPP for planting into greenhouses or fields to begin on-farm multiplication

Some seed growers bulk up NSPP plantlets and mini-tubers to sell to other seed growers. Others produce their own commercial crops from the NSPP seed

Covered Certified Seed Plants at the Atchley's Seed Farm

Selected Mini-tubers Bound for TC Cleanup and Multiplication at NSPP

CONTEXT GLOBAL DEVELOPMENT

RESEARCH & VARIETAL DEVELOPMENT

PVMI Variety Descriptions

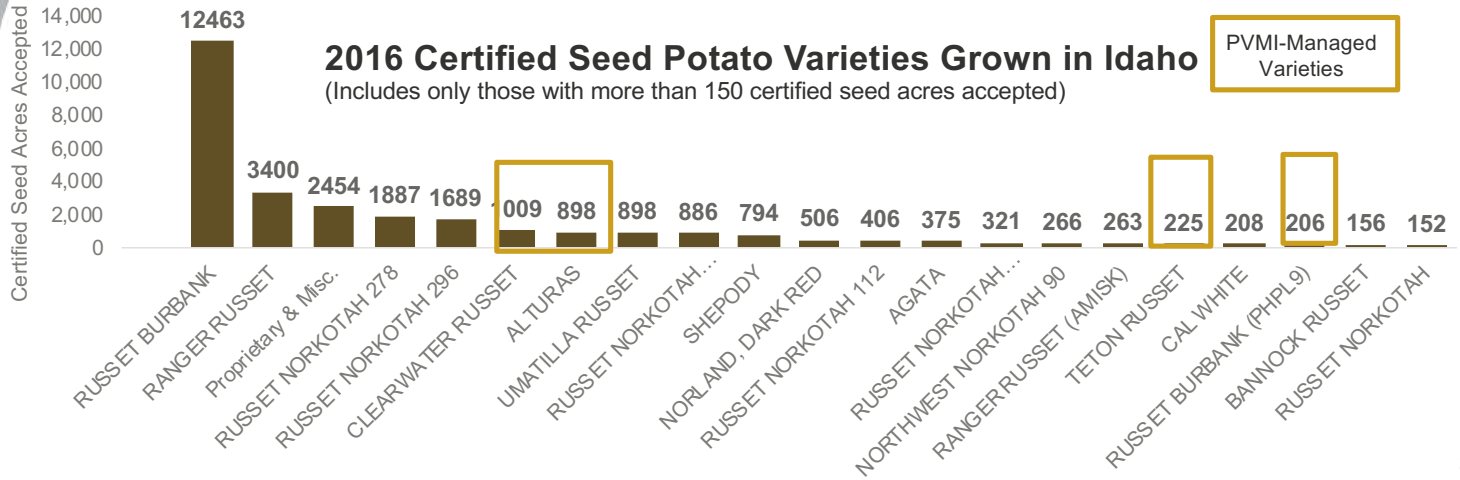
Varietal description for “Clearwater Russet”- a top PVMI variety chosen as one of McDonald’s seven Gold Standard Potato varieties

Varietal descriptions are published on the PVMI website along with agronomy notes and Cultural Management Recommendations from the University of Idaho

————Clearwater Russet Variety Details————

Clearwater Russet known as AOA95154-1 prior to release, is medium-late maturing, with oblong-long tubers that have medium-russet skin. Tubers exhibit excellent fry color out of storage and their attractiveness make this variety suitable for both processing and fresh market usage.

Clearwater Russet has high specific gravity and is resistant to sugar ends as well as most internal and external tuber defects. Clearwater Russet also is notable for having a higher protein content than those of standard potato varieties, with 38% greater concentration than Russet Burbank. Has moderate resistance to Verticillium.



CONTEXT | GLOBAL DEVELOPMENT

RESEARCH & VARIETAL DEVELOPMENT

The Tri-State Potato Breeding Program Makes National Headlines for New Variety Development

"Most of PVMI's foreign royalties come from Australia. Gemstar Russet, a good processing variety released in the late 1990s, is Australia's top Tri-State spud, though its susceptibility to PVY makes it less popular domestically." –PotatoPro

"The new Tri-State Potato Breeding Program varieties — Castle Russet and high-yielding Echo Russet — are billed as medium- to late-maturing potatoes appropriate for use in both the fresh market and processing. Testing has shown they also have good culinary qualities and cold sweetening resistance, so they fry with a light color even after months in storage." –Capital Press

CONTEXT | GLOBAL DEVELOPMENT

Demand Planning and Operations

CONTEXT | GLOBAL DEVELOPMENT

DEMAND PLANNING AND OPERATIONS

Early Generation Seed Deployment Model

	Breeder Seed	Foundation (Nuclear) Seed	Certified Seed	Commercialization
Who	**USDA-ARS** Aberdeen, ID	**Nuclear Seed Potato Program** University of Idaho (Moscow, ID)	**Independent Seed Growers**	**Independent Growers** Purchase seed from certified seed growers
Sector	Public	Public (but financially sustainable)	Private	Private
Input	80 lb. of Pre-Breeder Seed	800 lb. of Breeder Seed	8,000 lb. of mini-tuber, (200,000-250,000 Plantlets per year)	80,000 lb. Certified Mini-tuber Seed
Output	**800 lb. Breeder mini-tuber Seed** 	**8,000 lb. mini-tubers (Foundation Seed)** 	**80,000 lb. Certified mini-tubers** 	**49.5 billion pounds of Commercial Potatoes** 
Capital Sources	• State Funding • NIFA grants • Private company funding • Check off funds	• Nuclear seed sales cover all costs of nuclear seed production	• Certified seed sales • NOTE: State potato commissions collect assessments to fund state marketing and potato research	• Commercial seed sales • NOTE: potatoes USA collects an assessment to fund marketing activities for all U.S. potato growers

DEMAND PLANNING AND OPERATIONS

Flying A Ranch Spotlight

Owners:
Clen and Emma Atchley
Laura Pickard

Follows a 4-Year Production Planning Cycle For Each Variety Going to Commercial Growers

"Early" Certified Seed Producer	"Late" Certified Seed Producer	Sales of Certified Seed to Commercial Growers
• GH mini-tuber production managed by Emma; purchases clean TC material from NSPP • Built a 60' X 80' to generate their own EGS from PVMI varieties • Sole customer is their own on-farm certified seed production	• Laura grows a max of 6 varieties to ensure quality seed that will pass certification • 300 clean clones/lines are maintained at NSPP following this process • Solely a seed grower; perceives too much risk in mixing commercial and seed production	• Commercial growers are contracted to large processors • Most commercial growers work on short-term contracts, complicating the seed demand planning process • QSR and fry industry drive the varietal adoption of Idaho potato growers

Atchley Demand Planning Success Factors:

Evolved as an "early" certified seed grower to ensure they were receiving quality EGS for their seed operations. **Now, they only grow "early" certified seed for their own on-farm use**. This reduces the risk involved in selling to other seed growers including contract breaches and oversupply.

Flying A does not account for oversupply when planning for seed demand. This ensures each seed potato has a buyer, as quality losses from post-harvest storage make selling surplus seed potatoes to fresh pack channels difficult.

Flying A grows six varieties on 1,200 acres, which is viewed as the optimal capacity. Laura believes this is the capacity she can effectively manage at the quality needed without hiring additional help. Growing a moderate amount of varieties also helps with keeping disease pressure lower.

DEMAND PLANNING AND OPERATIONS

NSPP is Responsible for Cleaning-Up Promising Lines and Multiplying Breeder Seed to Nuclear Seed

NSPP receives material from Tri-State Breeders

- Material is available typically following 1st year of Regional Trials
- Industry is involved in selecting which varieties to clean and bulk for seed production

NSPP cleans the lines using ribavirin & heat treatment

- Cleaning process takes ~six months to one year to complete
- 300 clean clones/lines are maintained at NSPP following this process

Copy of plantlet sent to ICIA for entry-level testing

- PVY, PVA, PVX, PVS, PVM, PLRV, RLSV, PMTV, PSTVd, BRR, & Pectobacterium
- Testing re-occurs every 1-2 years depending on demand

Plantlets bulked in GH & mini-tubers produced

- 200,000- 250,000 plantlets are produced in 20' X 100' greenhouses
- Three crops of mini-tubers produced per year for ~6,000 lb. of seed as Nuclear Field Plantings

Mini-tubers sold to certified seed growers

- Contracted NSPP production is done on a hand-shake basis with ~50 growers
- Director of NSPP is working on developing more strict contractual agreements

Nuclear mini-tuber sales details:

$9.50/cube	For 20 plantlets
$33/lb.	For mini-tubers with a 400-600 lb./acre planting rate
$0.50-$1/cutting	For a cut mini-tuber (micro-tuber)

- Previous year demand largely determines the upcoming demand for new varieties
- Growers asked in to place orders by December (two years in advance); Planting material available in April (no contracts in place)
- If grower fails to pick up order, they are required to pay for it as part of a handshake agreement
- Growers that fail to pay for orders are banned from ordering again

CONTEXT | GLOBAL DEVELOPMENT

DEMAND PLANNING AND OPERATIONS

Royalty Fees and Licensing Overview

The following is required by seed growers when reporting royalties to PVMI:

- Written report of location, acreage, and number of units sold (cwt) of all licensed material produced or sold as seed
- Publish seed information in grower directory for their region
- Records should be retained for three years

Licensing Fee for Tri-State Varieties: $100 (Tri-State), $250 (Rest of U.S. International)

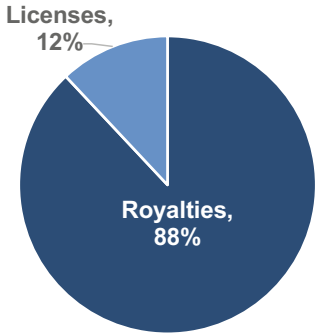
Royalties are paid annually on the units of seed sold (cwt) by the seed grower

Tri-State Growers:
$0.25/cwt
$1.00/cwt for specialty varieties

Rest of U.S:
$0.50/cwt
$1.00/cwt for specialty varieties

Rest of World:
$1.00/cwt
$2.00/cwt for specialty varieties

Royalties and licensing fees cover PVMI's operations. All excess funding is directed back to the Tri-State Program's research efforts



Licensing Agreements & Royalty Invoices are Available to Growers on the PVMI website

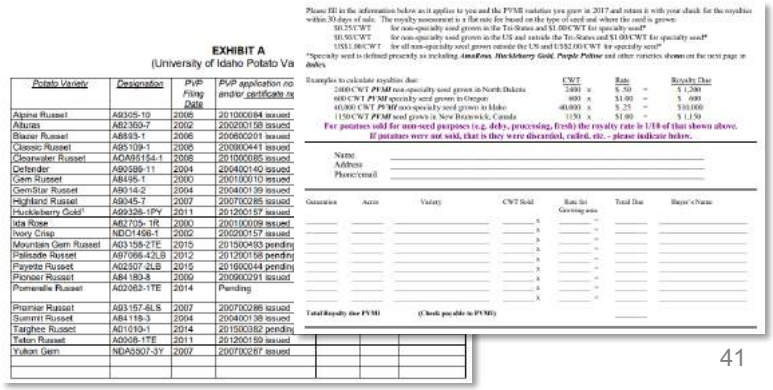


EXHIBIT A
(University of Idaho Potato Va

Potato Variety	Designation	PVP Filing Date	PVP application no and/or certificate no
Alpine Russet	A9305-10	2005	201000084 issued
Alturas	A82369-7	2002	200200158 issued
Blazer Russet	A8593-1	2006	200600201 issued
Classic Russet	A85109-1	2005	200800441 issued
Clearwater Russet	A0A85154-1	2008	201000085 issued
Defender	A90589-11	2004	200400140 issued
Gem Russet	A8495-1	2000	200100010 issued
GemStar Russet	A8614-2	2004	200400139 issued
Highland Russet	A9045-7	2007	200700285 issued
Huckleberry Gold[1]	A99326-1PY	2011	201200157 issued
Ida Rose	A82705- 1R	2000	200100059 issued
Ivory Crisp	NDO1456-1	2002	200200157 issued
Mountain Gem Russet	A03159-2TE	2015	201500483 pending
Palisade Russet	A97066-42LB	2012	201200158 pending
Payette Russet	A02507-2LB	2015	201600044 pending
Pioneer Russet	A84180-8	2009	200900291 issued
Pomerelle Russet	A03062-1TE	2014	Pending
Premier Russet	A83157-6LS	2007	200700286 issued
Summit Russet	A84118-3	2004	20040013[illegible] issued
Targhee Russet	A01010-1	2014	201500382 pending
Teton Russet	A0008-1TE	2011	201200159 issued
Yukon Gem	NDA8507-3Y	2007	200700287 issued

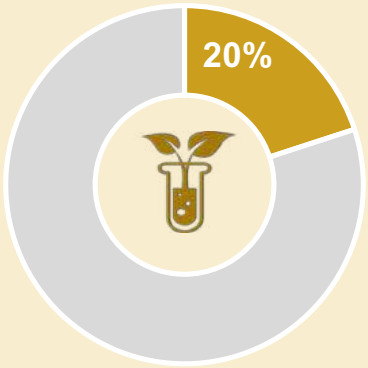
Financial Sustainability

CONTEXT | GLOBAL DEVELOPMENT

FINANCIAL SUSTAINABILITY

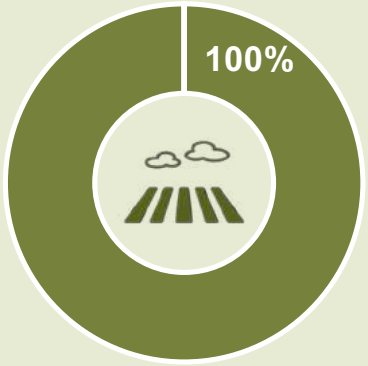
Financial Sustainability by EGS Value-Chain Step

Varietal Development & Breeder Seed Management



Public sector contributes 80% of operating costs; private funding from PVMI and industry associations fund the other 20%

Nuclear Seed Production (Foundation Seed)



NSPP is fully funded by the sale of mini-tubers and plantlets to certified seed growers

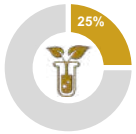
Certified Seed Production

Commercial seed companies fund certified seed production through seed sales

CONTEXT | GLOBAL DEVELOPMENT

FINANCIAL SUSTAINABILITY

Varietal Development & Breeder Seed Management Resourced Through Seven Channels; Public Sector Funds ~3/4 of Annual Operating Costs



Funding Source Color Key:

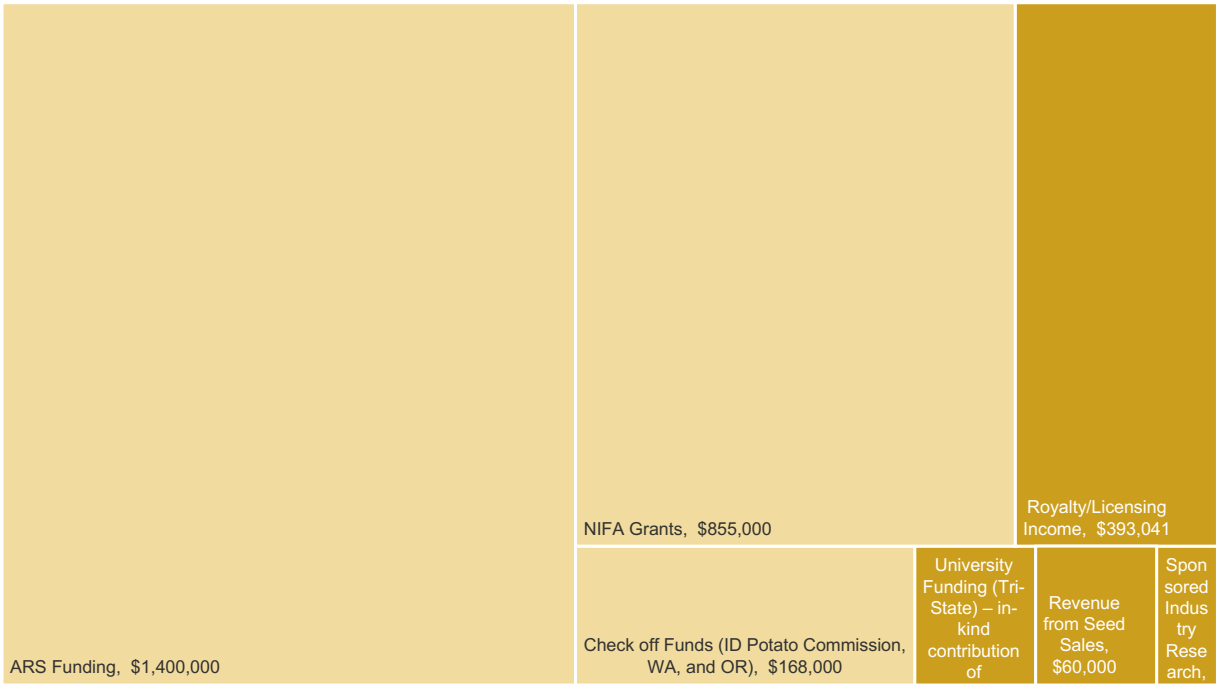
Public Sector Source

Private Sector Source

- University Funding (Tri-State) – in-kind contribution o greenhouses
- ARS Funding
- Check off Funds (ID Potato Commission, WA, and OR)
- Royalty/Licensing Income
- NIFA Grants
- Sponsored Industry Research
- Federal Formula Funds (non competitive)
- Revenue from Seed Sales

*in kind use of university greenhouses

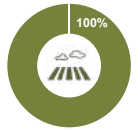
Sources of Varietal Development & Breeder Seed Management Operational Funding



CONTEXT | GLOBAL DEVELOPMENT

FINANCIAL SUSTAINABILITY

The Cost of Nuclear Seed Production is Recouped Through the Sale of Mini Tubers to Seed Growers



- The Nuclear Seed Potato Program (NSPP) operates on a yearly production planning cycle and encourages growers to plan well in advance of immediate needs.
- Growers typically place orders in December to receive mini-tubers or plantlets by the next fall.
- Informal agreements for picking up and paying for seed exist in place of binding contracts. Self-regulation in adhering to the informal agreements is made effective on the basis of grower reputation being dependent on following through on ordering commitments.

Mini-Tuber Production

Nuclear Seed Potato Program	
a. Volume of Nuclear Mini Tubers Produced (lbs.)	8,000
b. Price Charged for Nuclear Mini Tubers (per lb.)	$33.00
Mini Tuber Revenue	$264,000
c. Volume of Nuclear Plantlets Produced	200,000
d. Price Charged Per Nuclear Plantlet	$0.50
Nuclear Plantlet Revenue	$100,000
Revenue from Nuclear Plant Sales	**$364,000**

CONTEXT | GLOBAL DEVELOPMENT

FINANCIAL SUSTAINABILITY

Seed Growers Cultivate Over 32,500 Acres of Certified Seed, and Sell 976,500,000 lbs. of Production to Tri-State, US, and International Commercial Growers

Certified seed production is performed by ~65 certified seed producers, which are further split into early-stage certified seed growers that generally do greenhouse increases and late-stage certified seed growers who manage in-field increases from the bulked-up early certified seed

Certified seed growers are contracted by commercial growers for seed production

Certified Seed Growers	2016
a. Certified Seed Acres (Idaho)	32,550
b. Yield/ Acre (cwt)	300
c. Total Certified Seed Production (cwt) (a*b)	9,765,000
d. % Sold as Tri-State Certified Seed	25%
e. Total Certified Commercial Seed Sold (cwt) (a*b*c)	2,441,250
f. Seed Sold to Tri-State Growers	732,375
g. Seed Sold to Outside of Tri-State, Inside U.S.	976,500
h. Seed Sold to Outside of Tri-State, International	732,375
i. Average Price per cwt (Tri-State Growers)	$12
j. Average Price per cwt (Outside of Tri-State, Inside U.S.)	$12
k. Average Price per cwt (Outside of Tri-State, International)	$12
Total Certified Seed Revenue (f*i +g*j + h*k)	**$29,295,000**

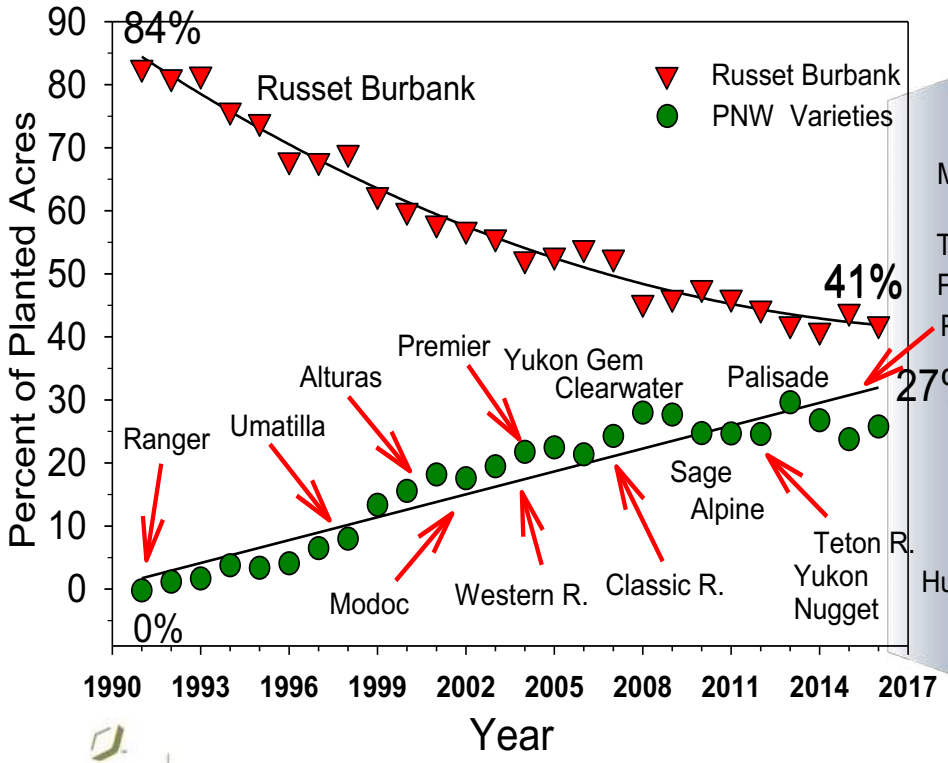
CONTEXT | GLOBAL DEVELOPMENT

SOURCE: Conversations with USDA-ARS researchers

Enabling Environment

ENABLING ENVIRONMENT

Demand for Quality Seed Instituted a System of Sustainable Actors & Varietal Replacement



"You can't push a rope."

Russet Burbank continues to be a dominant variety, but **Tri-State varieties are quickly catching up** in PNW acres planted due to perceived quality improvements

PVMI licenses to **~80% of certified seed growers** in Idaho despite public varieties being available and less expensive

Potato **grower interest in quality seed** is so high that 100% of seed must now be certified in Idaho

Nuclear seed production, certified seed production, new variety marketing, and royalty and licensing fee collection activities all function sustainably based on grower willingness to pay for quality seed

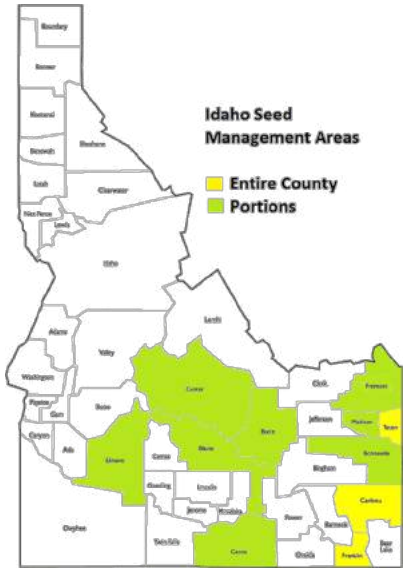
CONTEXT | GLOBAL DEVELOPMENT

SOURCE: Compiled from NASS; Data courtesy of Mark Pavek and Rick Knowles, WSU

ENABLING ENVIRONMENT

100% of Idaho Potato Seed is Inspected by Idaho Crop Improvement Association at Several Points of Production Before Certification

~75% of Idaho Potato Seed is Produced Within Seed Management Areas



Idaho Potato Seed Inspection Timeline

	Summer	*Fall*	*Winter*	*Spring*
Paperwork and Fees Paid	**2 Summer Field Inspections**	**Storage & Harvest Inspection**	**Post-Harvest Testing (Hawaii)**	**Shipping Point Inspection**
	• Minimum of two summer visual inspections per field • Checking for field requirements, identity and purity, phytosanitary tolerances	• Sanitation: Pre-harvest, old crop, cleanliness • Storage inspection: Lot identity, co-mingling	• Winter grow-out conducted in Hawaii • Lab testing (ELISA) for PVY and leaf roll done back in Idaho • BRR testing also completed	• REQUIRED for final certification • Federal-State Inspection Service • Considers conformity with seed potato grades

ICIA Transparency Success Factors:

- Field inspections and final certifications are completed by different personnel
- Returning seed inspectors do not certify the same fields year after year
- Idaho Dept. of Agriculture does final certification step at the shipping point

CONTEXT | GLOBAL DEVELOPMENT

ENABLING ENVIRONMENT

Winter Grow-Outs by ICIA in Hawaii Allow for Additional Disease Testing Absent of Extra Field Years

Hawaii Grow-Out Lots Tested For:

- **PVY Presence**
- **Leaf Roll Presence**

Each grower submits 400 tubers per lot to the Hawaii grow out to be tested for disease presence.

"We moved to Hawaii form California as a customer service to our growers. We can get them results more quickly which helps with their sales" –ICIA Area Manager

Idaho Crop Improvement Association's winter grow-out used to be conducted in California, but was moved to Hawaii in 2018 to **mitigate the risk of frost** and have **faster turnaround of seed health for growers**.

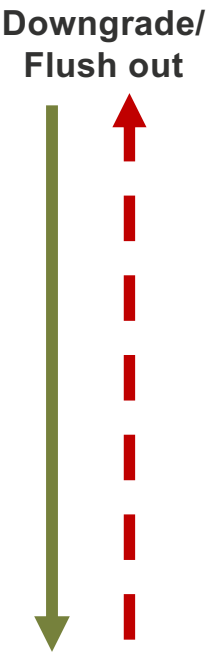
The decision to move to Hawaii was made based on **ICIA conversations with other states' crop improvement associations** that have had success growing through winter in Hawaii.

CONTEXT | GLOBAL DEVELOPMENT

ENABLING ENVIRONMENT

Idaho Potato Seed Generation System

Field Year	Generation	
	Breeder – Crosses, Evaluation	Originating Institution/University
	Tissue culture/Virus Elimination	
0	Tissue culture, greenhouse production	University/Early Generation Growers
1	Field Production: PVX-Nuclear	
2	PVX-G1	Sale for additional seed increase
3	PVX-G2	
4	G3	Sale for Commercial Production
5	G4	
6	G5	
7	G6	



CONTEXT | GLOBAL DEVELOPMENT

Source: ICIA Presentation

ENABLING ENVIRONMENT

The Idaho Seed Potato Law Ensures 100% of Seed Potatoes Sold Are Grown From Certified Seed

The Idaho Seed Potato Law was **enacted by the Idaho State Legislature** in 1996 largely in response to a nation-wide task force that recommended mandatory seed laws as a way to combat **bacterial ring rot outbreaks**. Idaho **potato growers** through the Idaho Potato Commission were the **catalyst for this change**. The law reads:

"All potatoes offered for sale, sold or delivered under contract or distributed into or within the state of Idaho for planting in the state of Idaho by any person from any state, territory, or country shall be certified and shall be accompanied by a certificate of inspection and a plant health certificate, and shall include the description of the grade, the findings of all inspections of each lot of seed, noting the name and amount of any disease observed, and generation of the potatoes and shall show that the potatoes were packed, sealed, and tagged under the certification standards of the state, territory, or country in which they were produced."

Idaho potato industry makes progress against diseases

The Idaho Crop Improvement Association has zero tolerance for ring rot, rejecting any seed lots in which the disease is found.

John O'Connell • Capital Press
Published on February 7, 2017 10:08AM

Source: Idaho Legislature, State of Idaho, Capital Press

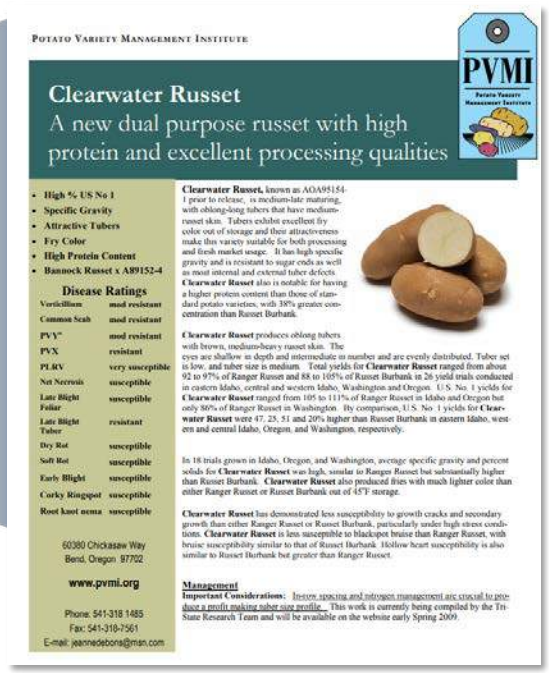
ENABLING ENVIRONMENT

University of Idaho Provides Management Bulletins for All PVMI Varieties as a Service to the Industry

Jeff Stark (University of Idaho) and Mark Pavek (University of Washington) prepare management bulletins for each variety that is released from Tri-State into the PVMI marketing program. Management data is collected during Tri-State Trials by university researchers. Each bulletin is posted on the PVMI website and accompanies the variety description and certified seed grower list.

Management Bulletins Address Grower Concerns On:

- **Seed and Pests**
- **Nutrients**
- **Irrigation**
- **Storage**
- **Harvest**



POTATO VARIETY MANAGEMENT INSTITUTE

PVMI

Clearwater Russet

A new dual purpose russet with high protein and excellent processing qualities

- High % US No 1
- Specific Gravity
- Attractive Tubers
- Fry Color
- High Protein Content
- Bannock Russet x A89152-4

Disease Ratings

Verticillium	mod resistant
Common Scab	mod resistant
PVY*	mod resistant
PVX	resistant
PLRV	very susceptible
Net Necrosis	susceptible
Late Blight Foliar	susceptible
Late Blight Tuber	resistant
Dry Rot	susceptible
Soft Rot	susceptible
Early Blight	susceptible
Corky Ringspot	susceptible
Root knot nema	susceptible

Clearwater Russet, known as AOA95154-1 prior to release, is medium-late maturing, with oblong-long tubers that have medium-russet skin. Tubers exhibit excellent fry color out of storage and their attractiveness make this variety suitable for both processing and fresh market usage. It has high specific gravity and is resistant to sugar ends as well as most internal and external tuber defects. **Clearwater Russet** also is notable for having a higher protein content than those of standard potato varieties, with 38% greater concentration than Russet Burbank.

Clearwater Russet produces oblong tubers with brown, medium-heavy russet skin. The eyes are shallow in depth and intermediate in number and are evenly distributed. Tuber set is low, and tuber size is medium. Total yields for **Clearwater Russet** ranged from about 92 to 97% of Ranger Russet and 88 to 105% of Russet Burbank in 26 yield trials conducted in eastern Idaho, central and western Idaho, Washington and Oregon. U.S. No. 1 yields for **Clearwater Russet** ranged from 105 to 113% of Ranger Russet in Idaho and Oregon but only 86% of Ranger Russet in Washington. By comparison, U.S. No. 1 yields for **Clearwater Russet** were 47, 25, 51 and 20% higher than Russet Burbank in eastern Idaho, western and central Idaho, Oregon, and Washington, respectively.

In 18 trials grown in Idaho, Oregon, and Washington, average specific gravity and percent solids for **Clearwater Russet** was high, similar to Ranger Russet but substantially higher than Russet Burbank. **Clearwater Russet** also produced fries with much lighter color than either Ranger Russet or Russet Burbank out of 45°F storage.

Clearwater Russet has demonstrated less susceptibility to growth cracks and secondary growth than either Ranger Russet or Russet Burbank, particularly under high stress conditions. **Clearwater Russet** is less susceptible to blackspot bruise than Ranger Russet, with bruise susceptibility similar to that of Russet Burbank. Hollow heart susceptibility is also similar to Russet Burbank but greater than Ranger Russet.

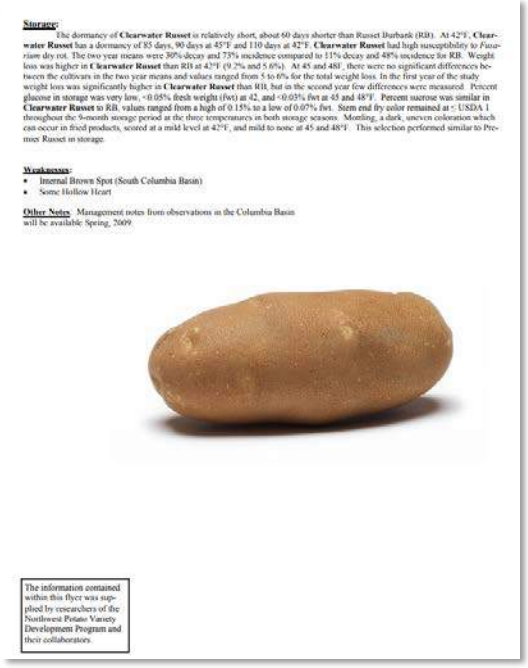
Management

Important Considerations: Inrow spacing and nitrogen management are crucial to produce a profit making tuber size profile. This work is currently being compiled by the Tri-State Research Team and will be available on the website early Spring 2009.

60380 Chickasaw Way
Bend, Oregon 97702

www.pvmi.org

Phone: 541-318 1485
Fax: 541-318-7561
E-mail: jeannedebons@msn.com



Storage:

The dormancy of **Clearwater Russet** is relatively short, about 60 days shorter than Russet Burbank (RB). At 42°F, **Clearwater Russet** has a dormancy of 85 days, 90 days at 45°F and 110 days at 42°F. **Clearwater Russet** had high susceptibility to *Fusarium* dry rot. The two year means were 30% decay and 73% incidence compared to 11% decay and 48% incidence for RB. Weight loss was higher in **Clearwater Russet** than RB at 42°F (9.2% and 5.6%). At 45 and 48F, there were no significant differences between the cultivars in the two year means and values ranged from 5 to 6% for the total weight loss. In the first year of the study weight loss was significantly higher in **Clearwater Russet** than RB, but in the second year few differences were measured. Percent glucose in storage was very low, <0.05% fresh weight (fwt) at 42, and <0.03% fwt at 45 and 48°F. Percent sucrose was similar in **Clearwater Russet** to RB, values ranged from a high of 0.15% to a low of 0.07% fwt. Stem end fry color remained at < USDA 1 throughout the 9-month storage period at the three temperatures in both storage seasons. Mottling, a dark, uneven coloration which can occur in fried products, scored at a mild level at 42°F, and mild to none at 45 and 48°F. This selection performed similar to Premier Russet in storage.

Weaknesses:

- Internal Brown Spot (South Columbia Basin)
- Some Hollow Heart

Other Notes Management notes from observations in the Columbia Basin will be available Spring, 2009.

The information contained within this flyer was supplied by researchers of the Northwest Potato Variety Development Program and their collaborators.

CONTEXT | GLOBAL DEVELOPMENT

ENABLING ENVIRONMENT

Financial Enabling Environment

FUNCTION	DETAIL
National Commodity Price Hedge	**Price Loss Coverage (PLC):** Producers who hold base acres of wheat, feed grains, rice, oilseeds, peanuts, and pulses (covered commodities) are eligible to enroll in the PLC program on a commodity-by-commodity basis. Payments are made when market prices fall below the reference price set in the 2014 Farm Act.
Regional Commodity Price Hedge	**Agriculture Risk Coverage (ARC):** Producers who hold base acres of rice, wheat, feed grains, oilseeds, peanuts, and pulses (covered commodities), are eligible to enroll in ARC on a county or individual farm basis. County ARC payments are made when county crop revenue for the enrolled commodity drops below 86 percent of the county benchmark revenue. Individual ARC payments are made when the actual individual crop revenues—summed across all covered commodities on the ARC farm—are less than 86 percent of the ARC individual benchmark revenue.
Commodity Marketing Credit	**Marketing Assistance Loan Program**: A post-harvest nonrecourse commodity loan program with marketing loan provisions for producers of wheat, corn, grain sorghum, barley, oats, upland cotton, extra-long staple (ELS) cotton, long- and medium-grain rice, soybeans, other oilseeds, peanuts, wool, mohair, honey, dry peas, lentils, and small and large chickpeas. When the adjusted world price for rice (as calculated weekly by USDA), falls below loan rates, marketing loan provisions allow for repayment of loans at the lower price and for loan deficiency payments to producers who choose not to place commodities under loan.
National Crop Insurance	**Traditional crop insurance:** Producers can purchase insurance policies at a subsidized rate under Federal crop insurance programs. These insurance policies make indemnity payments to producers based on current losses related to either below-average yields (crop yield insurance), or below-average revenue (revenue insurance). Both yield and revenue insurance options are available.

Source: USDA ERS

ACKNOWLEDGE-MENTS

Thank you for your time and support in the development of this Idaho Potato EGS profile

Stakeholders Consulted

Name	Position	Organization
Dr. Rich Novy	Research Geneticist	USDA-ARS
Dr. Jonathan Whitworth	Research Plant Pathologist	USDA-ARS
Dr. Jeff Stark	Superintendent	University of Idaho Aberdeen Research & Extension Center
Emma Atchley and Laura Pickard	Idaho Seed Growing Family	Flying A Ranch
Richie Toevs	Idaho Seed Grower	Toevs Farm LLC
Jennie Durrin	Director	University of Idaho Nuclear Seed Potato Program
Dr. Ben Eborn	Extension Agricultural Economist	University of Idaho
Paul Patterson	Agricultural Economist (retired)	University of Idaho
Alan Westra	Area Manager	Idaho Crop Improvement Association
Todd Carter	Superintendent	University of Idaho Tetonia Research & Extension Center

CONTEXT | GLOBAL DEVELOPMENT

thank you

CONTEXT | GLOBAL DEVELOPMENT

5550 Wild Rose Lane, Suite 40039
West Des Moines, IA 50266
P: 515.225.2204
F: 515.225.0039

www.cgd.global
www.contextnet.com

Mark Nelson
+1 607.592.4947