

Early Generation Seed Case Study

Arkansas Rice

April 2018



Table of Contents

Arkansas Rice Case Study

Executive Summary

1. Market Dynamics

2. Leadership

3. Research & Varietal Development

4. Demand Planning & Operations

5. Financial Sustainability

6. Enabling Environment

Appendix



Executive Summary

University of Arkansas Breeding Program Enables the Seed System

VARIETAL DEVELOPMENT & SEED DEPLOYMENT



Varietal Development

Varietal development for Arkansas rice is conducted through the University of Arkansas System's Division of Agriculture and is supported by check off funds collected by the Arkansas Rice Research and Promotion Board, as well as through grant funding and other state and federal funding sources.



Seed Multiplication

All breeder and foundation seed multiplication occur as part of the Arkansas Foundation Seed Program at the Rice Research & Extension Center (RREC). The Foundation Seed Program also works closely with the Arkansas Division of Agriculture's Crop Variety Improvement Program when increasing new varieties.



Certified Seed Production

Certified seed production is performed by ~60 commercial seed growers that purchase foundation seed from the Arkansas Foundation Seed Program. These growers are members of the Arkansas Seed Growers Association and their seed is sold by members of the Arkansas Seed Dealers Association, which provides advocacy, coordination, and regulatory functions for seed production.

FARMER PRODUCTION, MARKETING, AND KEY DEMAND SEGMENTS



Farm Production

There are more than 2,500 rice farms in the state of Arkansas, and 96% of them are family owned. In 2017, over 1.5 million acres of rice were farmed in the state. The Arkansas Rice Research and Promotion Board estimates that the industry contributes more than \$4 billion to state's economy annually, and accounts for more than 25,000 jobs. Rice is the state's second highest-valued commodity, and Arkansas' top agricultural export.



Industry Advocacy

The Arkansas Rice Research and Promotion Board advocates for the interests of state rice growers. Its operating funds are raised through levies on the sale of grain. The Board funds industry promotional efforts at a state and national level through USA Rice. It also funds research activities at the University of Arkansas, including varietal development, research projects, on-farm trials, and Arkansas Foundation Seed program initiatives.



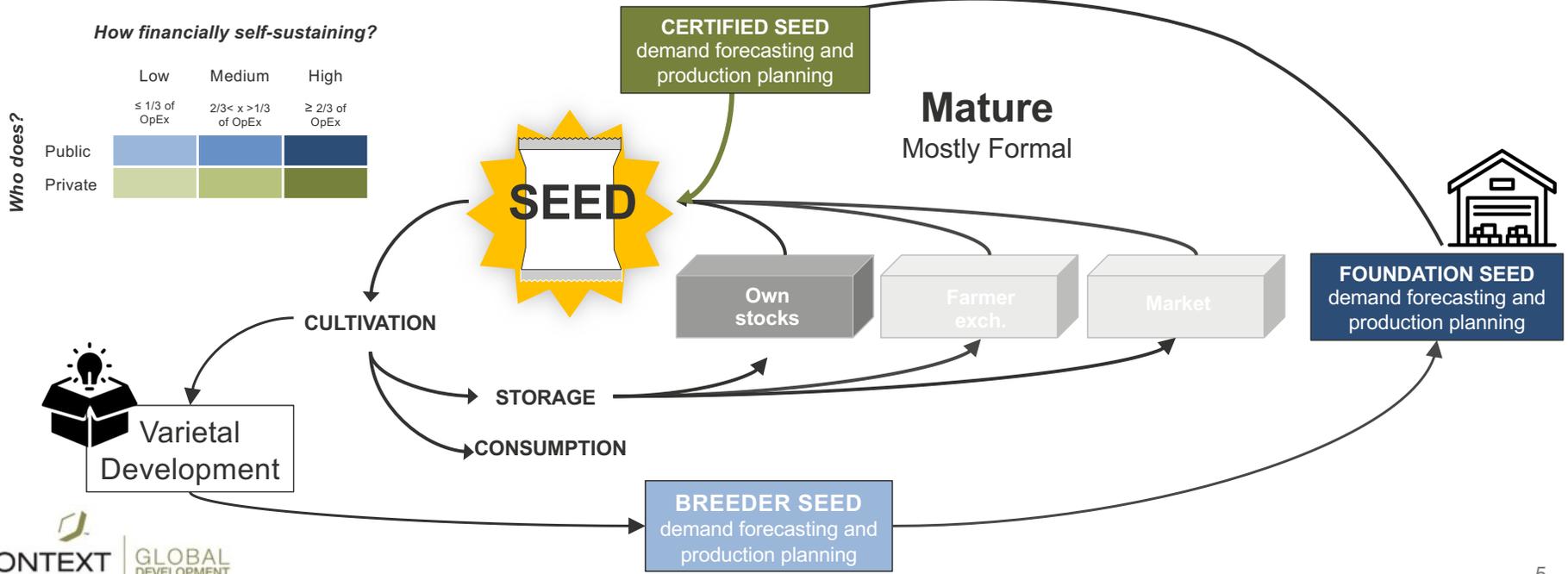
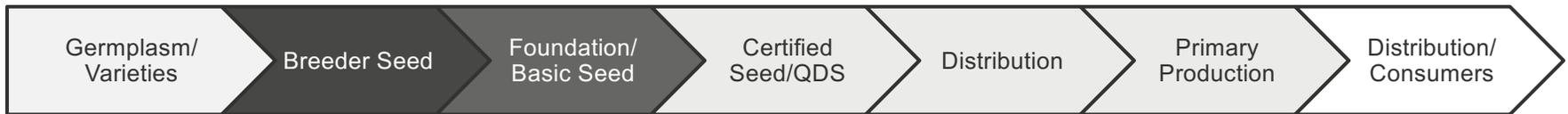
Demand Segments

Arkansas rice production commands a premium globally due to its strong quality perception. Key demand segments for Arkansas rice are the domestic long-grain market, long-grain import markets (e.g., Mexico, Haiti, and Canada), and domestic processors of medium-grain.

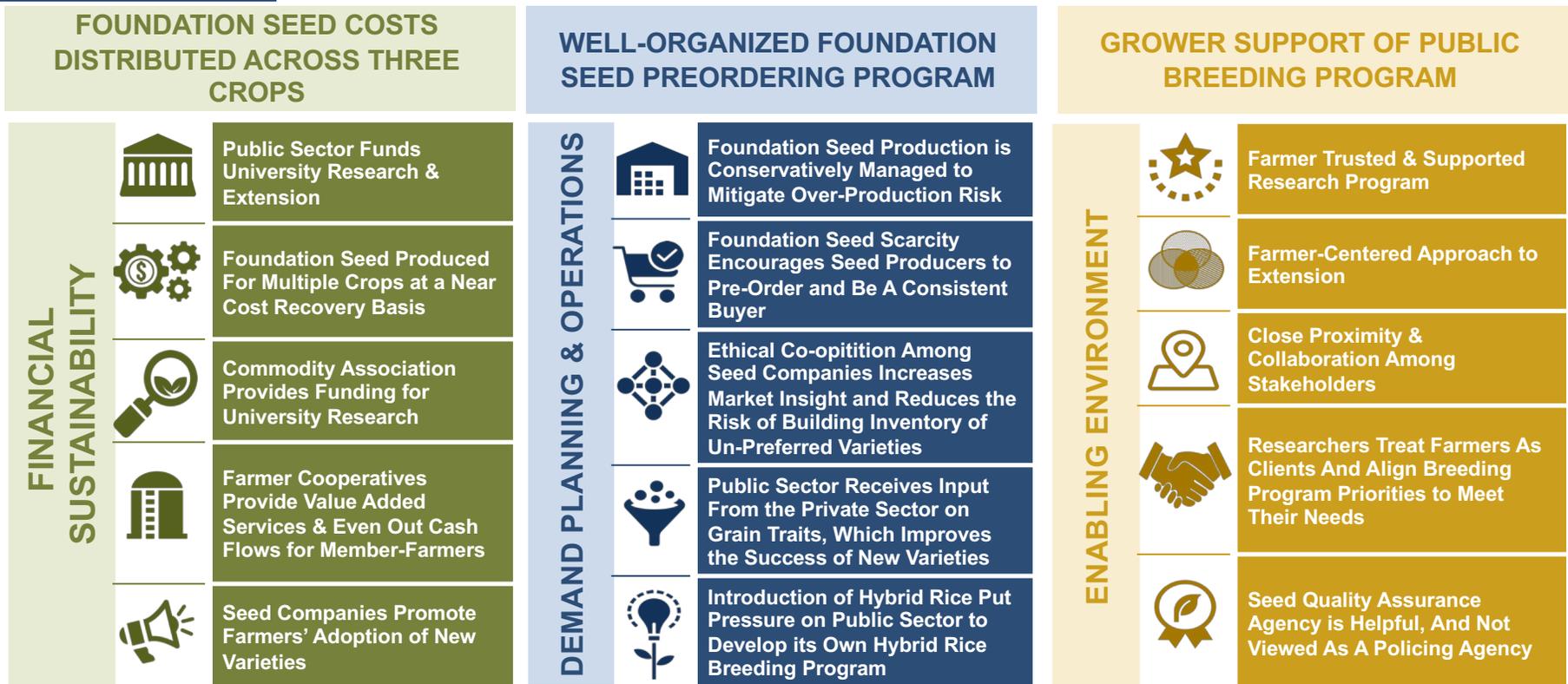
ENABLING ENVIRONMENTSTAKEHOLDERS

Arkansas Seed Council | [Arkansas Seed Dealers Association](#) | [Arkansas State Plant Board](#) | [Rice Research Verification Program](#) | [USA Rice](#)

Public Sector Funds Varietal Development and Subsidizes Foundation Seed Costs



Summary of EGS System Success Factors



Financial Sustainability

	<p>Public Sector Funds University Research & Extension</p>	<p>Research, varietal development, foundation seed production, and grower extension functions are sustained through public sector budget allocation and grants that fund operating costs and capital expenditures. Key operating costs that are funded by the public sector include researcher salaries and benefits, consumables, and facility upkeep (office, labs, acclimatized storage, fields).</p>
	<p>Foundation Seed Produced For Multiple Crops at a Near Cost Recovery Basis</p>	<p>The public sector leverages physical and human capital across three crops (rice, soybean, and wheat) to produce and sell foundation seed to certified seed growers. Foundation seed production at the University of Arkansas is professionally managed and respected by the industry. Foundation seed sales for rice are estimated to cover 70% of the Arkansas Foundation Seed program's all-in seed production costs.</p>
	<p>Commodity Association Provides Funding for University Research</p>	<p>The Rice and Research Promotion Board commits half of its budget to support research rice research projects. Research funds are distributed through a competitive project application process in which extension and research scientists from the University of Arkansas and elsewhere submit project proposals to the Rice Research and Promotion Board for review and potential approval.</p>
	<p>Grower Cooperatives Provide Value Added Services & Even Out Cash Flows for Grower-Members</p>	<p>Grower cooperatives have responded to the evolving needs of their grower-members. Cooperatives serve growers in commodity processing and marketing capacities and are tied directly into the commercial market. These ties to the market add tremendous value to growers as cooperatives can provide input on market needs directly to the growers and the breeding programs. They also add value for growers by leveraging their increased purchasing and buying power to reduce the cost of inputs and services, and to negotiate higher prices for farmer production. Other valued services that they provide to growers include quality control and financial liquidity through cash advances when the commodity is delivered to the mill, but has not yet been sold.</p>
	<p>Seed Companies Promote Growers' Adoption of New Varieties</p>	<p>Seed companies play a critical role in increasing the adoption of new varieties. They pre-order foundation seed in Year 1, plant in Year 2, and sell in Year 3. The two-year lead time between the foundation seed order and the certified seed sale introduces significant demand risk that seed companies mitigate through trust-based relationships with their grower customers, sales & marketing efforts (incl. varietal demonstration events for customers), and close relationships with breeders and researchers.</p>

Demand Planning and Operations



Foundation Seed Production is Conservatively Managed to Mitigate Over-Production Risk

The Arkansas Foundation Seed (AFS) program bases its foundation seed demand forecast on pre-orders, plus an estimate for in-season orders. To mitigate overage costs associated with holding inventory over for another season, demand forecasts are pragmatic. Demand for AFS produced foundation seed normally surpasses supply.



Foundation Seed Scarcity Encourages Seed Growers to Pre-Order and Be Consistent Buyers

Seed growers pre-order foundation seed because it is a necessary input of their business and stock-outs are expected. To manage scenarios where supply does not meet demand, customers can achieve *Priority Customer* standing through consistent early ordering of foundation seed, which gives them priority in getting their seed orders filled.



Ethical Co-opitition Among Seed Companies Increases Market Insight and Reduces the Risk of Building Inventory of Un-Preferred Varieties

Seed companies compete for certified seed sales, but have a shared interest in the growth of the Arkansas rice industry. They collaborate on issues of mutual importance and advocate for companies' interests through the Arkansas Seed Dealers Association, which is led by seed company executives. Regional seed companies are critical enablers of the seed system, and rely on each other to execute their businesses. For example, when a seed company is short of seed, they reach out to other seed companies to satisfy their requirements. Cooperation between competitors also allows for enhanced coordination around product life cycles and demand planning. Communication between companies allows for phasing out of un-preferred varieties, as well as allocation of resources to ensuring adequate supplies of and support for new and existing varieties.



Public Sector Receives Input From the Private Sector on Grain Traits, Which Improves the Success of New Varieties

The public and private sectors collaborate to evaluate and screen research lines for traits that increase the profitability of commercial rice production (e.g., yield, stability, and disease tolerance). The public sector leverages private sector feedback on field performance trials and grain testing to increase the efficiency of its resource allocation, and improve the commercial adoption of new varieties.



Introduction of Hybrid Rice Put Pressure on Public Sector to Develop its Own Hybrid Rice Breeding Program

The introduction of hybrid rice in Arkansas by RiceTec in the early 2000s disrupted the rice seed industry. For many Arkansas rice farmers, the higher yield potential of hybrid rice seed was worth the increased seed costs compared to conventionally bred public varieties. The commercial success of hybrid rice, which is evidenced by its planting on approximately 40% of Arkansas rice acres in 2017, led Arkansas rice growers to fund a public hybrid rice breeding program at the Rice Research & Extension Center in order to develop lower cost, public sector alternatives. This is evidence of the pride, loyalty, and ownership that Arkansas growers have in and for the University of Arkansas breeding program.

Enabling Environment

	<p>Grower Trusted & Supported Research Program</p>	<p>Arkansas rice growers trust the Arkansas Rice Research and Extension program to deliver research findings and new varieties that improve the profitability of their operations. Growers have been planting Arkansas-released varieties for more than 100 years and have tremendous pride in the institution’s contribution to the development of the rice industry. Growers, through the Rice Research and Promotion Board, have been actively involved in guiding research priorities and disseminating information from the Arkansas Rice Research and Extension program.</p>
	<p>Grower-Centered Approach to Extension</p>	<p>Qualified extension agents develop personal, trust-based relationships with growers who rely on their recommendations when making profit-impacting decisions including cultivar selection, planting timing, seeding rates, row spacing, irrigation, pesticide application, irrigation, drain timing, and harvest. Breeders, pathologists, entomologists, agricultural engineers, and agricultural economists at the Arkansas Rice Research and Extension program all act as a team to develop useful, timely information that allows growers to make well-informed decisions.</p>
	<p>Close Proximity & Collaboration Among Stakeholders</p>	<p>Arkansas rice production is concentrated in the eastern counties of the state, which spans ~250 miles from north to south. The close proximity of actors, including breeders, researchers, agricultural extension officers, seed companies, seed certifiers, growers, grower cooperatives, and processors encourages the development of trust-based relationships and an intense focus on addressing the prioritized issues of a largely homogeneous agro-ecological environment.</p>
	<p>Researchers Treat Growers As Clients And Align Breeding Program Priorities to Meet Their Needs</p>	<p>Rice researchers and growers have an interdependent relationship. Growers rely on researchers to develop new varieties, and researchers rely on growers to fund their research through grain levies. This symbiotic relationship promotes a strong feedback loop between stakeholders, who have a mutual interest in increasing the profitability of rice farming in Arkansas.</p>
	<p>Seed Quality Assurance Agency is Helpful, And Not Viewed As A Policing Agency</p>	<p>The Arkansas State Plant Board is viewed as adding value to the system and not as a policing agency. Arkansas rice’s premium quality reputation is supported by the agency’s efforts to assure the quality of seed that is sold in the state. Stakeholders – especially breeders, seed companies, and growers – appreciate the role that the Arkansas Plant Board plays in protecting the industry.</p>

EGS Seed System Pain Points

Financial Sustainability

The levies collected (check off funds), on the sale of the commodity have been flat for decades despite rising costs due to inflation. To overcome the widening funding gap, research administrators are allocating more of their time to identify alternative funding sources, which is time that could be better spent developing new varieties and supporting the breeding team.

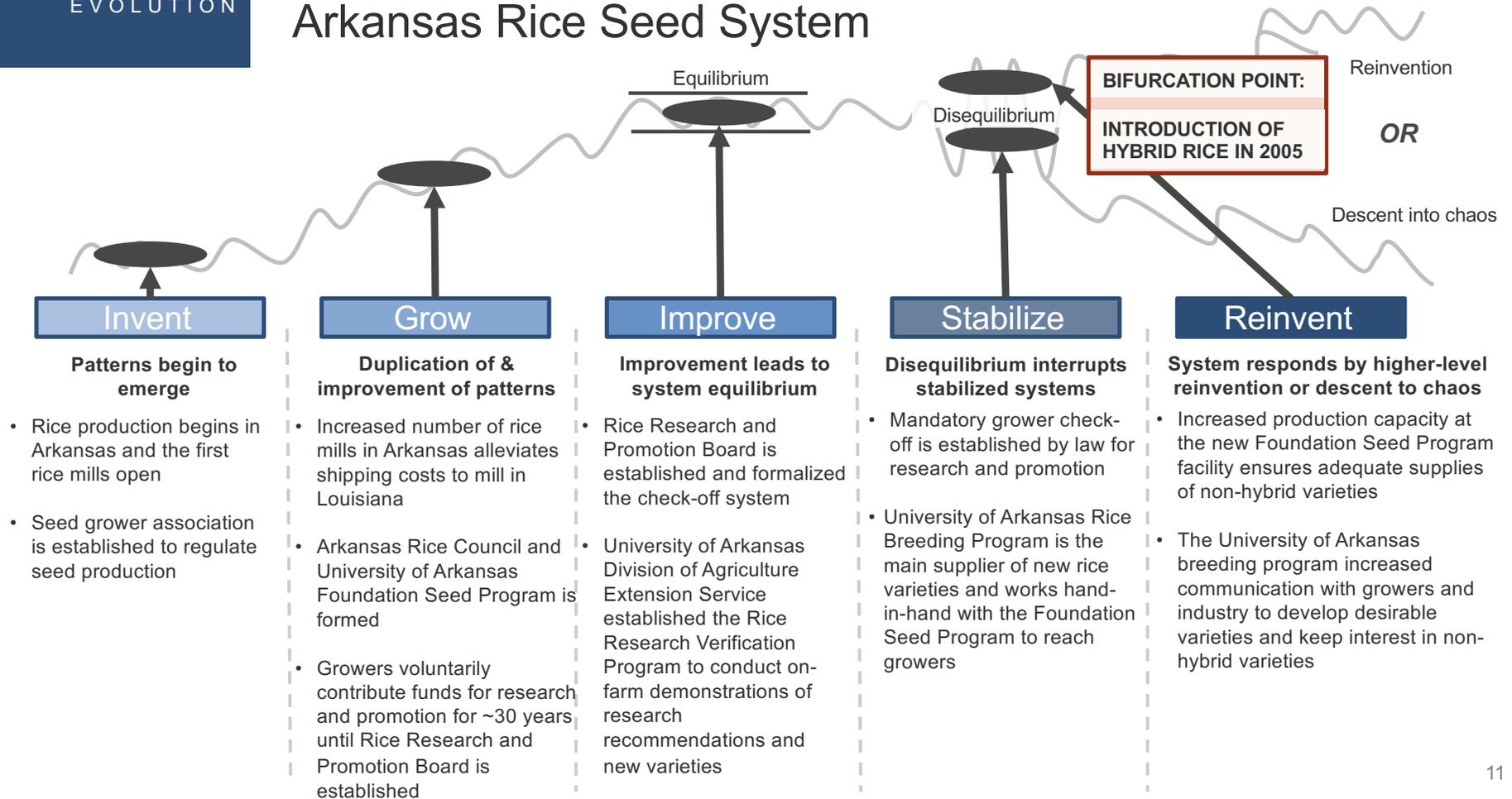
Demand Planning & Operations

Foundation seed orders made through the AFS require a 50% down payment at the time of the order. Seed growers' cash flow constraints often lead them to under-order foundation seed due to this requirement. The net impact is that less foundation seed is produced than would be actually demanded by the market without the down payment requirement.

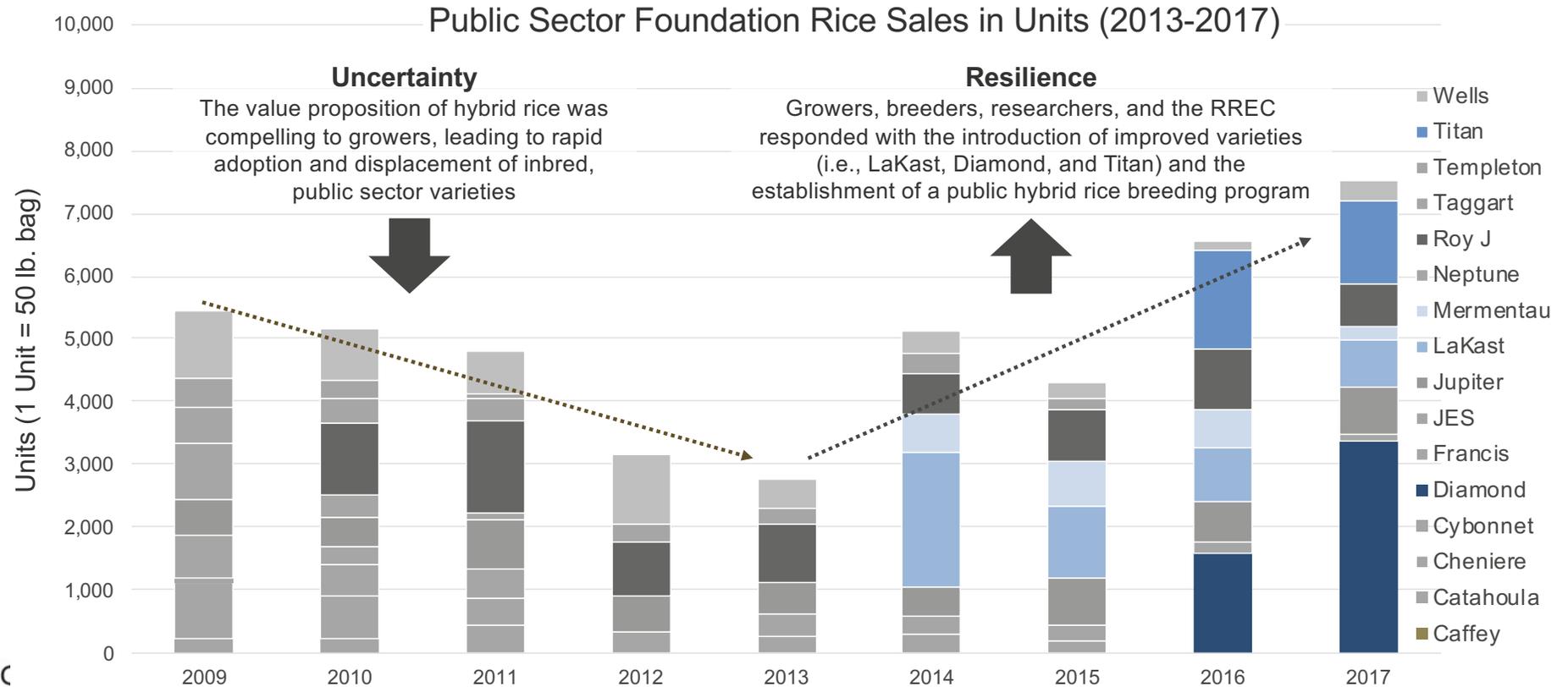
Enabling Environment

A deep level of trust must exist between governments, extension agencies, and local growers for the system to function sustainably and successfully. A strong level of trust exists in the Arkansas rice industry, but it took several years and the cooperation of each and every market player to develop the trusting relationships that are the backbone of the model.

Key Events That Shaped the Evolution of the Arkansas Rice Seed System



Introduction of Hybrid Rice in Arkansas by RiceTec in the 2000s Disrupted the Public Sector-Led Rice Seed Industry



Data. Source: 1) Mane, R. and Watkins, K. 2016. Economic Analysis of the University of Arkansas System Division of Agriculture Rice Foundation Seed Program: Cost and Price. AAES Research Series 643.

Arkansas Rice EGS System Timeline

	1900-1979	1980-1999	2000-Present
FINANCIAL Levies Royalties	<p>1950- Arkansas Rice Council formed what was to become the Rice Research & Promotion Board (RRPB). Rice growers voluntarily contributed funds to promote the rice industry</p> <p>1979- Rice growers voluntarily contribute check off funds specifically for rice variety research, but not in an organized fashion until RRPB is established</p>	<p>1985- AR Rice Research and Promotion Board est. and begins formal Rice Checkoff program under Act 725, combining the efforts of the promotion and research voluntary grower funds</p> <p>1987- Increase of refundable rate to 3 cents per bushel from original 2 cents</p> <p>1999- Act 16 est. mandatory assessment that is in place today of 1.35 cents/bushel producers and first buyers</p>	<p>2016- Emergency tariff rate quota funds allocated to Rice Research and Extension Center from USA Rice to supplement low check-off dollars for developing high nighttime temp varieties</p> <p>Continued funding from private, governmental, NGO organizations, and licensing and royalty fees for agricultural research</p>
DEMAND PLANNING/OPERATIONS Technology Systems	<p>1906- First Arkansas rice mill opens in Stuttgart, AR. Four more mills added by 1910. Reduced grower shipping costs to Louisiana mills.</p> <p>1950- Flood Control Act enacted by congress to provide rice irrigation from White River following concerns about drought and depletion of the Grand Prairie water table</p> <p>1951- U. of Ark Foundation Seed Program est. due to support from wheat and rice breeding programs</p> <p>1955- Governmental acreage controls stabilized rice production to 500,000 acres</p> <p>1974- Rice marketing quotas lifted and rice acreage increased throughout Arkansas</p>	<p>Continued demand for rice and wheat varieties; and new demand for soybean varieties</p> <p>Increased communication between commodity organizations and growers and industry</p>	<p>2005- RiceTec releases first hybrid rice varieties</p> <p>2016- New, improved AR Foundation Seed facility opened in Stuttgart, AR</p>
ENABLING ENVIRONMENT Policies Stakeholders	<p>1917- AR Seed Growers Association est.</p> <p>1919- International Crop Improvement Association established (name later changed to Association of Official Seed Certification Agencies)</p> <p>1921- AR Rice Growers Coop established to combat low rice prices following WWI. This coop eventually became Riceland Foods, Arkansas' first coop and mill</p> <p>1925- University of AR Rice Research and Extension Center est. joint program between USDA and U. of AR</p> <p>1931- AR Plant Board designated by AR legislature as seed certification agency for Arkansas. Official Standards for Seed Certification established (circular 15)</p> <p>1950- Arkansas Rice Council est.</p> <p>1970- Shifting of crop acres from pasture to row crops due to increased global market demand (wheat) and better variety availability</p>	<p>1980- University of Arkansas rice breeding program was established due to funding from the Rice Research and Promotion Board</p> <p>1983- University of AR Division of Agriculture Cooperative Extension Service est. Rice Research Verification Program</p> <p>1998- Dale Bumpers National Rice Research Center est. in Stuttgart, AR</p>	<p>Continued demand for herbicide resistant, non-hybrid varieties bolsters need for breeding program</p>

Arkansas Rice EGS System Timeline Key Takeaways

- University of Arkansas' Foundation Seed Program was not developed in a one-crop vacuum. The rice and wheat industries were both instrumental in funding the beginning stages of the program as growers desired to regulate their seed inputs following WWII. The soybean industry's success in later years helped to further advance the Foundation Seed Program, including the ability to build new and improved seed facilities as costs were shared across the three crops.
- Grower desire for a quality seed supply and improved varieties predates the required checkoff programs started in 1985. For several years prior, growers voluntarily contributed to funds that were directed toward industry promotion and later on, specifically toward the research of new rice varieties. Grower willingness to pay out of their own profits was a key factor in the success of the breeding program and overall rice industry growth. These two voluntary funding groups eventually merged to become the AR Rice Research and Promotion Board, which is still in place today. Grower interest in serving in leadership and committee roles were the key to these organizations' successes throughout the history of the industry.
- Establishment of rice mills in close proximity to Arkansas rice growers reduced shipping costs and transportation time lags, improving market access for growers. These mills proved to be so important to industry growth that five mills were established in Arkansas over the span of 4 years (1906-1910).



Market Dynamics

Arkansas is the Rice Production Leader in the US

The U.S. Ranked 11th Globally for Total Rice Production in 2016

#Country	2016 Production Total (tons)	% of Total
1 China (incl. Taiwan)	232,199,894	28%
2 India	174,632,558	21%
3 Indonesia	85,027,260	10%
4 Bangladesh	57,849,000	7%
5 Vietnam	47,780,952	6%
6 Myanmar	28,240,115	3%
7 Thailand	27,794,275	3%
8 Philippines	19,389,970	2%
9 Brazil	11,684,408	1%
10 Pakistan	11,453,371	1%
11 United States of America	11,183,755	1%
12 Others	109,568,586	13%
Total	816,804,143	100%

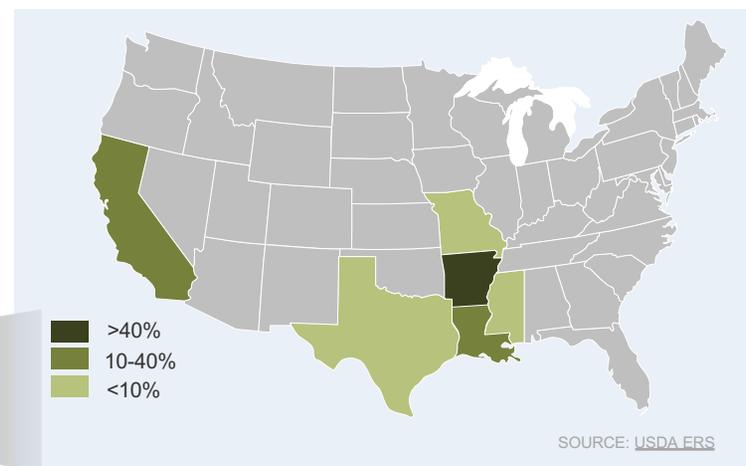
SOURCE: FAOSTAT

Asian countries account for about 90% of total world rice production

The majority of rice production in the US is long-grain varieties (~75%), followed by medium-grain varieties (~24%)

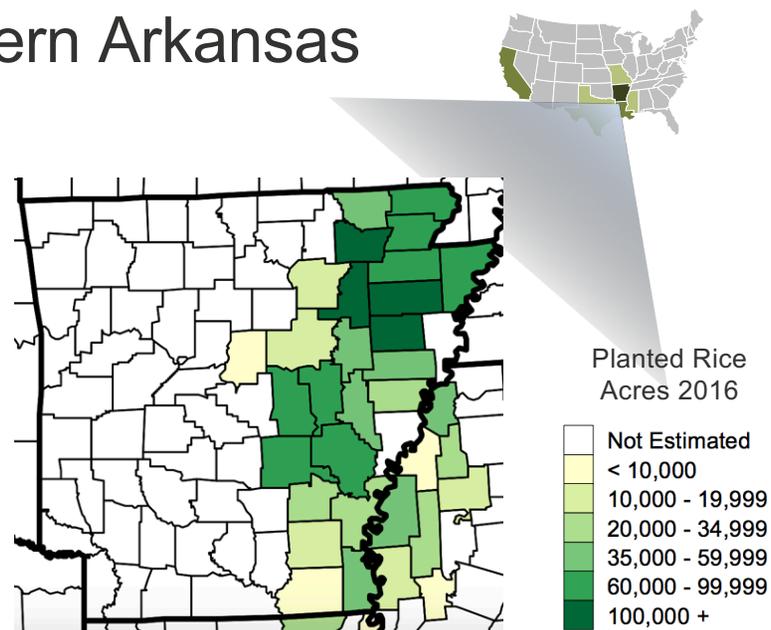
Arkansas leads the US in long-grain rice production, while California dominates in medium- and short-grain rice production

Arkansas Ranks First in Total Rice Production in the United States



Rice is Produced in Eastern Arkansas

Arkansas rice production is concentrated in the eastern counties of the state, which spans ~250 miles from north to south. The close proximity of actors, including breeders, researchers, agricultural extension officers, seed companies, seed certifiers, growers, grower cooperatives, and processors encourages the development of trust-based relationships, and an intense focus on addressing the prioritized issues of a largely homogeneous agro-ecological environment.



Source: [USDA NASS](#)

Arkansas farmers grow long-grain and medium-grain rice

Over 70% of Arkansas rice production is long-grain¹

Medium-grain rice is produced to meet processor demand

Arkansas Rice Grower Profile

In 2017, Arkansas growers produced 239,254,400 bushels of rice on 1.521 million acres. Rice is the state's second highest-valued commodity (behind cotton), and Arkansas' top agricultural export.

Demographics

Farms: 2,500
Production Acres¹: 1,521,000
Average Farm Size: 608 Acres/Per

Economic Impact

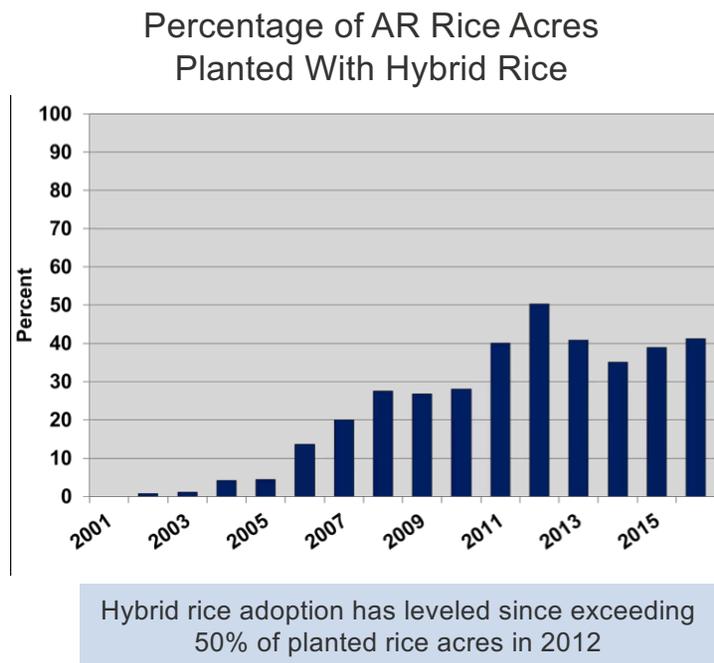
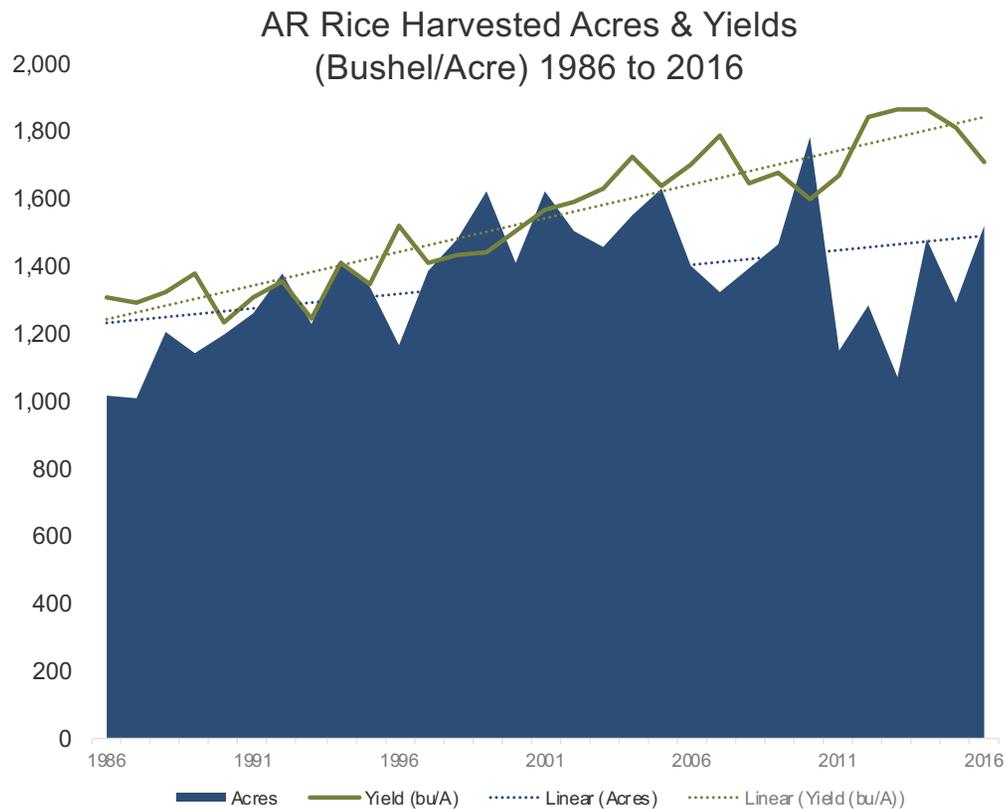
The rice industry contributes more than **\$4 billion** to Arkansas' economy annually, and accounts for more than **25,000 jobs**.

Arkansas is home to 2,500 rice farms with 96% of them being family owned.
(Source: Arkansas Rice Federation)

#ArFBFarmFact

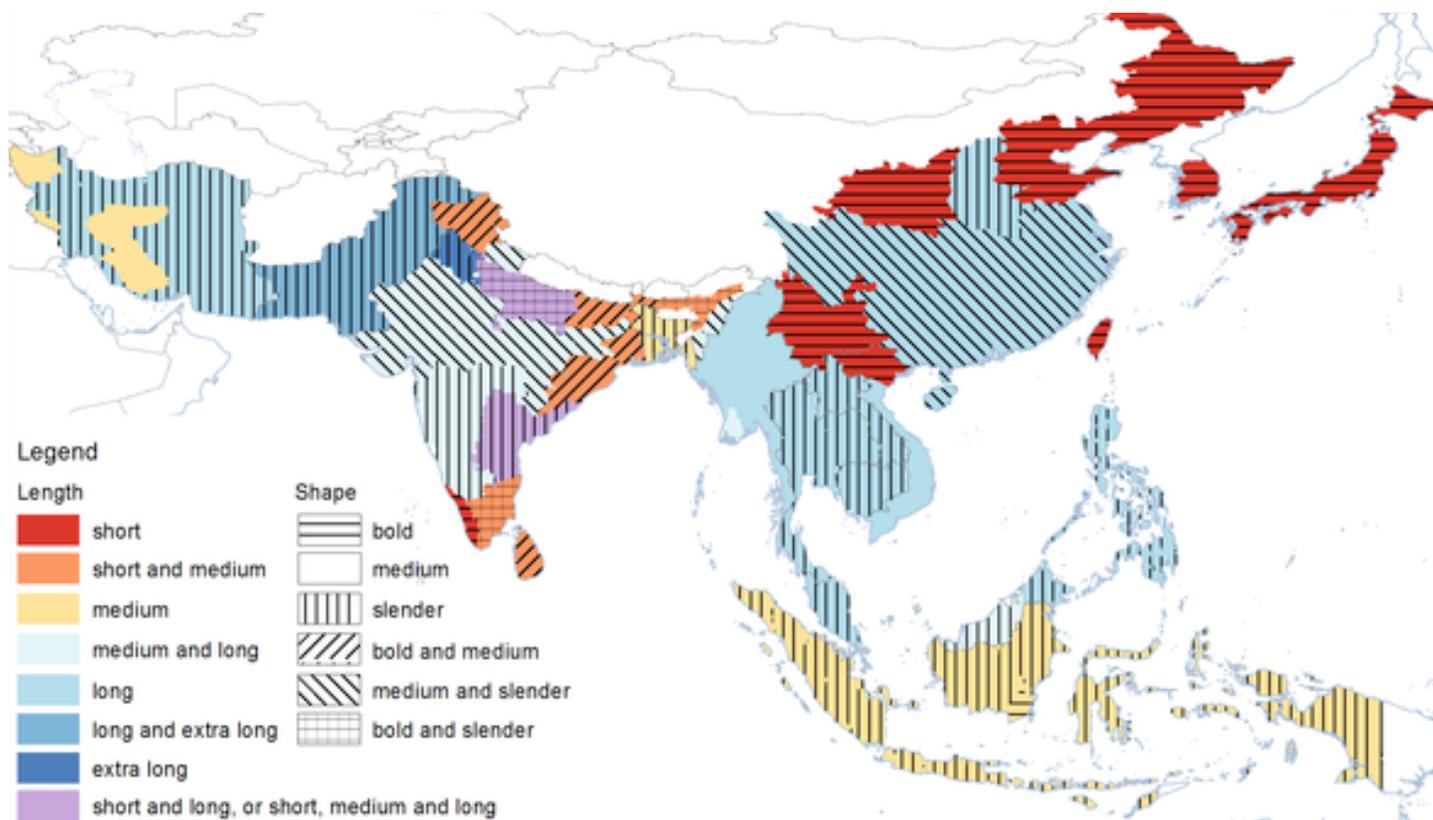
FARM BUREAU ARKANSAS

Harvested Acres and Yields Have Increased Over Time



SOURCE: History of Arkansas Rice Acreage and Yield

Consumer Preference Informs Rice Production Systems By Region

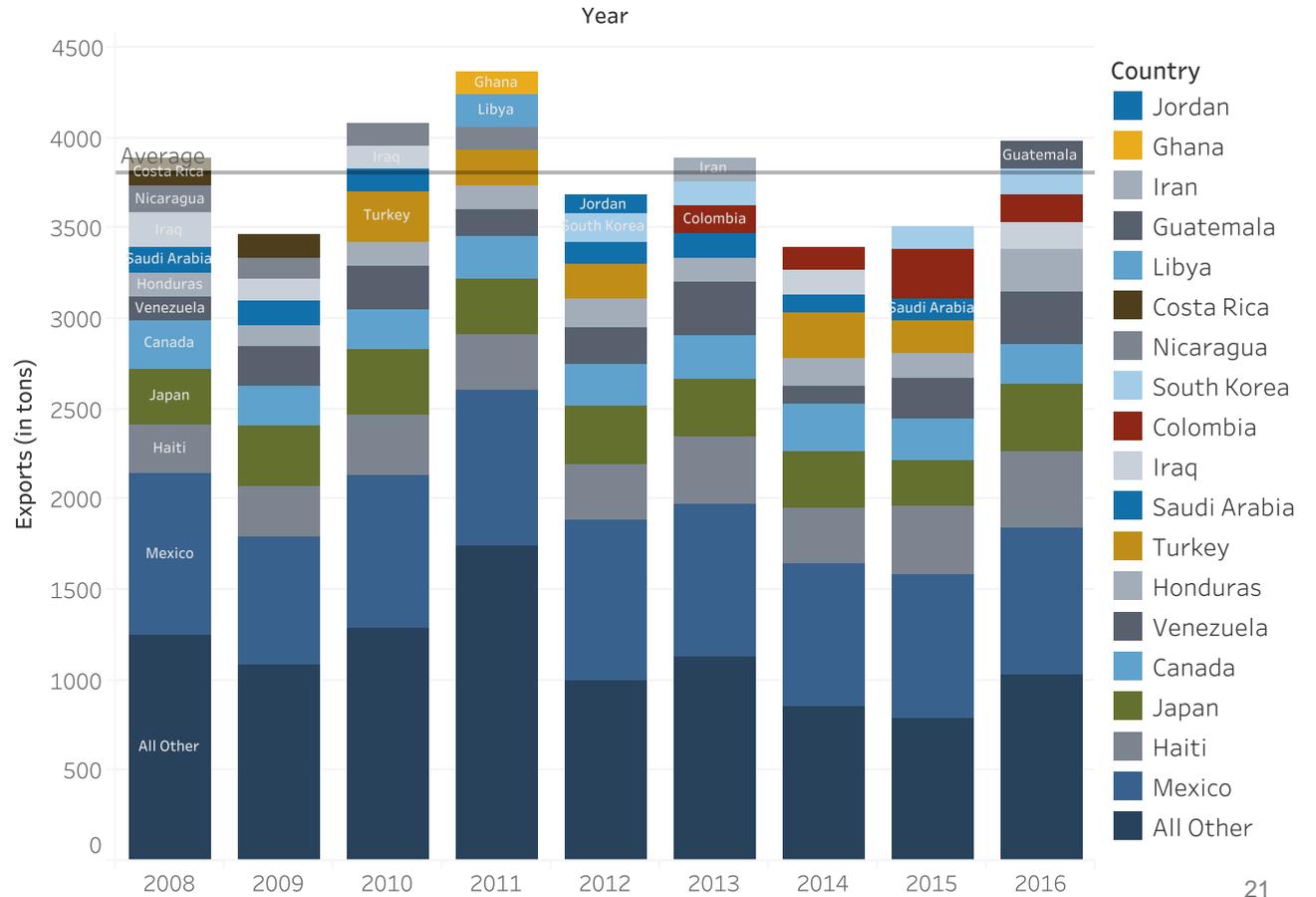


Over 50% of US Rice Production is Exported

Mexico has consistently been the largest export market (20.5% in 2016)

Central & South American countries represent over 50% of the export market

Export volumes fluctuated within a 1,000 ton range between 2008 and 2016





Leadership

University Breeding Program Enables the Seed System

VARIETAL DEVELOPMENT & SEED DEPLOYMENT



Varietal Development

Varietal development for Arkansas rice is conducted through the University of Arkansas System's Division of Agriculture and is supported by check off funds collected by the Arkansas Rice Research and Promotion Board, as well as through grant funding and other state and federal funding sources.



Seed Multiplication

All breeder and foundation seed multiplication occur as part of the Arkansas Foundation Seed Program at the Rice Research & Extension Center (RREC). The Foundation Seed Program also works closely with the Arkansas Division of Agriculture's Crop Variety Improvement Program when increasing new varieties.



Certified Seed Production

Certified seed production is performed by ~60 commercial seed growers that purchase foundation seed from the Arkansas Foundation Seed Program. These growers are members of the Arkansas Seed Growers Association and their seed is sold by members of the Arkansas Seed Dealers Association, which provides advocacy, coordination, and regulatory functions for seed production.

FARMER PRODUCTION, MARKETING, AND KEY DEMAND SEGMENTS



Farm Production

There are more than 2,500 rice farms in the state of Arkansas, and 96% of them are family owned. In 2017, over 1.5 million acres of rice were farmed in the state. The Arkansas Rice Research and Promotion Board estimates that the industry contributes more than \$4 billion to state's economy annually, and accounts for more than 25,000 jobs. Rice is the state's second highest-valued commodity, and Arkansas' top agricultural export.



Industry Advocacy

The Arkansas Rice Research and Promotion Board advocates for the interests of state rice growers. Its operating funds are raised through levies on the sale of grain. The Board funds industry promotional efforts at a state and national level through USA Rice. It also funds research activities at the University of Arkansas, including varietal development, research projects, on-farm trials, and Arkansas Foundation Seed program initiatives.



Demand Segments

Arkansas rice production commands a premium globally due to its strong quality perception. Key demand segments for Arkansas rice are the domestic long-grain market, long-grain import markets (e.g., Mexico, Haiti, and Canada), and domestic processors of medium-grain.

ENABLING ENVIRONMENTSTAKEHOLDERS

Arkansas Seed Council | [Arkansas Seed Dealers Association](#) | [Arkansas State Plant Board](#) | [Rice Research Verification Program](#) | [USA Rice](#)

Organizational Leadership by Value-Chain Step

UofA **DIVISION OF AGRICULTURE**
RESEARCH & EXTENSION
University of Arkansas System



LEADERSHIP

Organizational Value Chain Leadership Summary

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
ORGANIZATION	<p>Rice Research and Extension Center</p> 	<p>Rice Research Verification Program</p>	<p>Arkansas Foundation Seed program</p>	<p>Arkansas Seed Growers Association</p> 	<p>Arkansas Seed Dealers Association</p> 	<p>Arkansas State Plant Board</p> 	<p>Grower Cooperatives</p> 	<p>Arkansas Rice Research & Promotion Board</p> 
VALUE CHAIN ROLE	<ul style="list-style-type: none"> Varietal Development 	<ul style="list-style-type: none"> On-farm demonstration of research recommendations 	<ul style="list-style-type: none"> Varietal licensing Foundation seed production, storage, delivery, and sale 	<ul style="list-style-type: none"> Seed grower advocacy, coordination, and oversight 	<ul style="list-style-type: none"> Seed seller advocacy, coordination, and oversight 	<ul style="list-style-type: none"> Certification of foundation and commercial seed 	<ul style="list-style-type: none"> Aggregate, store, mill, and market members' grain production to improve farmer value capture 	<ul style="list-style-type: none"> Advocate for the interests of Arkansas rice growers
MAJOR FUNDING SOURCES	<ul style="list-style-type: none"> State Funding Grants Arkansas Rice Research & Promotion Board 	<ul style="list-style-type: none"> State Funding Arkansas Rice Research & Promotion Board 	<ul style="list-style-type: none"> Foundation seed sales Arkansas Rice Research & Promotion Board supports special projects 	<ul style="list-style-type: none"> Membership dues Members profit from production of certified seed for seed dealers 	<ul style="list-style-type: none"> Seed producer membership dues Members profit from the sale of certified seed 	<ul style="list-style-type: none"> Seed certification charges 	<ul style="list-style-type: none"> Cost-recovery through service provision (ex. milling and storage) 	<ul style="list-style-type: none"> Assessments on the sale and purchase of grain (more commonly known as a: commodity checkoff program)
FINANCIAL SUSTAINABILITY	SUBSIDIZED BY THE PUBLIC & PRIVATE SECTOR		PARTIALLY SUBSIDIZED	FINANCIALLY SUSTAINABLE	FINANCIALLY SUSTAINABLE	FINANCIALLY SUSTAINABLE	FINANCIALLY SUSTAINABLE	FINANCIALLY SUSTAINABLE

LEADERSHIP

Rice Research and Extension Center



RREC main building in Stuttgart, AR.
Rice is the main focus at the RREC, but the program also houses soybean, wheat, and corn research.

Funding Sources:



- State Funding
- Grants
- Arkansas Rice Research & Promotion Board



SOURCE: University of Arkansas Extension Newsletter RREC

Mission:

“Improve rice production for Arkansas farmers through **applied research** and **extension programs** to develop **sustainable systems** that protect our natural resources, enhance the economy of Arkansas and provide a food product consumed worldwide.”

Program Details:

The programs that originate at RREC have resulted in the development of **40+ improved rice varieties**, coupled with crop management recommendations, that are **variety specific**, are **sustainable**, and ensure the **overall success** of the variety when it is produced by Arkansas rice farmers.

New variety and crop management recommendations are communicated to Arkansas rice growers through field days, grower meetings, fact sheets, and newsletters. New communication technology has been incorporated so that information can be obtained through the internet, social media (Facebook and twitter), and e-mail.

The RREC features 1,000 acres of research capacities near Stuttgart, AR. It is home to research labs, seed cold storage facilities, state-of-the-art breeding equipment, research fields, and meeting facilities that members of the Arkansas rice community use to connect throughout the year. Extension agents, through the RREC, hold Rice College every other year to educate growers about new varieties, water quality, mechanization, and fertility, among many other topics.



Seed storage room at the RREC. Extensive cold storage space allows breeders to maintain clean lines of released varieties over several years following release.

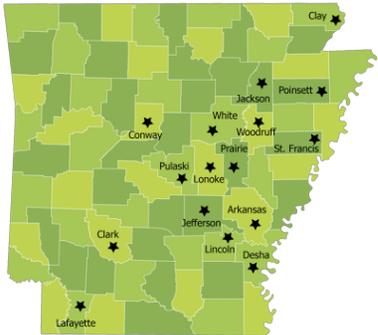
Staffing:

An interdisciplinary approach to breeding and variety release is made possible by staffing rice breeders, plant pathologists, entomologists, engineers, and economists at the RREC. There are currently twelve scientists dedicated to improving rice varieties at the RREC.

“We house all relevant disciplines in the faculty here at the station, permitting us to be housed right in the heart of the rice-growing region of the state, performing our work...that’s unique to this location.” – Jarrod Hardke, Extension Agronomist

LEADERSHIP

Rice Research Verification Program (RRVP)



RRVP Presence in Arkansas:

In 2016, farms in 15 counties throughout Arkansas were enrolled in the RRVP, representing an average field size of 54 acres.²

Funding Sources



- State Funding
- Arkansas Rice Research & Promotion Board

Purpose:

The RRVP is an interdisciplinary effort between growers, county extension agents, extension specialists, and researchers. The RRVP is an on-farm demonstration of all the research-based recommendations developed by the University of Arkansas Division Of Agriculture for the purpose of increasing the profitability of rice production in Arkansas.¹

Program Details & Objectives:

The RRVP was established in 1983 as a public exhibition of the implementation of research-based Extension recommendations in a field-scale farming environment on released AR rice varieties. More than 460 rice fields have been enrolled in the RRVP since 1983.

Program Objectives²:

- Demonstrate and verify research-based recommendations on Arkansas rice varieties on Arkansas farms
- Develop a database for economic analysis of all rice production aspects
- Demonstrate benefits of available technology and inputs for higher commercial rice yields
- Promote timely implementation of rice management practices among growers
- Provide training and assistance to county agents and growers with limited rice production experience

Through the RRVP, growers receive field consultations and research-based growing guidelines from extension agents to follow for a minimum of two growing seasons. Growers collect field data throughout the two growing seasons and report the results back to the program. These results, along with the growing guidelines connected with them, are published by the University of Arkansas Division of Agriculture for all farmers to reference. Growers who participate in this program are given the freedom to choose their own varieties for growing and are permitted to keep the grain that they grow, but incur all production costs. Two technical support (verification scientists), oversee 7-10 farms each and are overseen by the extension rice agronomist.

Impact²:

- Enables on-farm verification of AR released varieties under recommended conditions with published data and growing information made available to growers, at no cost, to improve their growing practices
- Increased yields per acre from following RRVP guidelines: average yield per acre in RRVP 2011-2015: **182 bushels/acre**, whereas the state average for all AR growers for the same time period was 163 bushels/acre



SOURCE: (1) University of Arkansas Extension
(2) University of Arkansas Extension-RRVP Final Report 2016

OPERATIONS

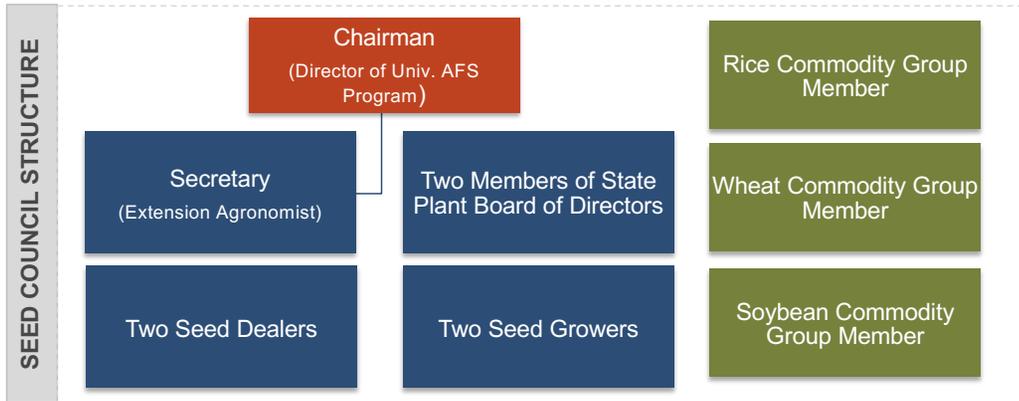
Arkansas Foundation Seed Program

Mission: "The primary goal of AFS is to make seed of newly released and proven varieties available to all Arkansas growers as quickly as possible. It is felt that foundation-grade seed should be placed in the grower's hands who are most assured of maximum production and who are most likely to maintain the seed within the Seed Certification Program standards."

Program Details: "The Arkansas Foundation Seed (AFS) Program, based at the Rice Research and Extension Center near Stuttgart, will be responsible for the production of foundation seed and assisting breeders in the production of breeder's seed, as requested, and/or where required by a contract or license agreement managed by the University of Arkansas System Division of Agriculture Crop Variety Improvement Program."

"When plant materials are licensed or managed under an agreement, AFS works closely with the Crop Variety Improvement Program. The two entities, along with a lead University of Arkansas System Division of Agriculture Extension Specialist, work to coordinate seed for county and regional field tests, manages the increase and distribution of foundation seed stock and handles revenues from seed sales and non-licensed products."

Arkansas Seed Council: "The Arkansas Seed Council is an eleven-member advisory group whose sole function is to assist in the allocation of foundation-grade seed produced by the Arkansas Agricultural Experiment Station. The Seed Council approves requests for foundation seed based on the applicants experience, equipment and known ability as a seed producer."



Arkansas Seed Growers Association and Arkansas Seed Dealers Association

Arkansas Seed Growers Association

This 100-year-old organization is the oldest farm organization still in operation in Arkansas. It is described by members as a “family organization” that connects rice growers with seed growers, providing them with more options when purchasing seed.

The Association assists the Arkansas rice industry through having a voice in foundation seed allotment, promoting Arkansas agriculture alongside the University of Arkansas, supporting legislation, and providing grower education during Association meetings, where growers receive updates from University breeders and researchers on new varieties, a State Plant Board Update, and other pertinent topics.

Funding Sources



- Membership dues

Arkansas Seed Dealers Association



Objectives:

- Foster, promote improve and protect the seed industry and its allied branches
- Encourage and promote a united effort for increasing the purity and improving the quality of all seeds sold
- Aid in maintaining high standards of quality of seeds and encourage the observance and use of such standards by all members
- Promote firmer business relations between all those engaged in the rice trade everywhere and manage trade differences and disputes arising between members, or between members and non-members

Funding Sources



- Seed producer annual membership dues (\$275)

Association Details

- Holds annual Summer and Winter Conventions
- Members must apply for a Seed Dealer's License through the Arkansas State Plant Board

How these organizations work together:



Seed growers order foundation seed from RREC



Seed dealers contract production of certified seed from **seed growers** at a premium to grain prices



AR Plant Board Inspects certified seed grower fields and issues seed certification tags



Seed growers deliver certified seed to **seed dealers** (seed companies)



Seed dealers sell certified seed to rice growers

Arkansas State Plant Board



F

Mission:

"The mission of the Arkansas State Plant Board is to protect and serve the citizens of Arkansas and the agricultural and business communities by providing information and unbiased enforcement of laws and regulations thus ensuring quality products and services."

Program Details:

The Seed Division's responsibilities are both **regulatory** and **service based**: All activities are coordinated through the Division Director.

1

Regulatory:

Serves to protect the consumer from poor quality or mislabeled planting seed and to provide a level opportunity for the selling of seed through field inspections in areas where agricultural seed is sold, regulation compliance checks, and sampling of seed being sold. Field inspectors ensure that all the seed being offered for sale has a certification label.

Seed Certification / Quality Assurance - Identity Preserved:

2

As the Official Seed Certifying Agency for Arkansas, the Seed Certification Program provides constant supervision to the production of seed with the highest genetic and mechanical purity. Rigid standards of quality are set-up by the Plant Board for the three classes of certified seed. Detailed records are maintained for four generations of seed production. Each generation must be field inspected and then laboratory tested. Only when all standards are met can certified tags/labels be issued.

The Quality Assurance / Identity Preserved program offers third-party unbiased inspections for seedsmen. An individual program is designed to meet the needs of each participating company and fees are assigned according to the type of services needed.

3

Official Arkansas Seed Laboratory:

The seed laboratory tests both regulatory samples from field and seed compliance tests, and service samples, which are seed samples submitted by seedsmen or farmers for the purpose of obtaining information about seed quality for planting purposes.



The State Plant Board divides the state into 4 districts, each with their own supervisor and inspectors. In total, there are ~40 certified seed growers registered with the Plant Board.

Funding Source



Seed certification charges

Grower Milling Co-Operatives

“Grower cooperatives help us create more value for the rice industry than we ever could individually.” –Michael Smith, Riceland Foods

Cooperatives Create Value for Farmers



- Founded in 1921
- All rice is produced in the United States
- Grower-owned cooperative with 5,500 members who are also Riceland’s stockholders and growers
- Operates 20 grain elevators in Arkansas
- Provides grain testing for University of Arkansas rice varieties
- Offers products for retail, industrial, institutional food service, animal feed, and pet food industries



- Founded in 1943
- Grower-owned cooperative with 2,500 members
- Operates 4 rice mills and 12 storage and receiving locations
- Annual milling rate is 60 million bushels
- Serves the rice industry through foodservice, retail, private label, exports, and industrial products

Co-Operative Financing



- Growers become members of the cooperatives and pay a membership fee annually, which is often determined as a percentage of rice production sold to the cooperative
- Membership fees are deducted from growers’ production checks
- Grower-members are paid on the number of bushels of rice delivered to cooperatives as part of the profit-sharing model
- Cooperative pricing may vary based on rice quality and variety

Cooperatives Service Offerings Have Evolved To Meet Grower Needs

The services that cooperatives offer their grower-owners has evolved with the industry. When growers needed seeds, cooperatives stepped in to provide them. When growers wanted independent grain testing capabilities, cooperatives resourced laboratories.

Cooperatives are a key factor in unsticking the bottlenecks that inhibit grower value capture by offering commodity processing services like milling, grain storage, marketing, value-addition through new product development, contracted production, and by providing industry-specific research to breeding programs.

Value Addition



Cooperatives help alleviate growers’ cash flow uncertainties

Cooperatives offer growers options for financing throughout the growing year. Growers can choose a pooling option, where they receive a payment advance of ~75% during the growing year, as well as a final advance at the end of the year, allowing for a spreading out of cash flow instead of one lump sum at the end of production. Growers can also opt to enter a voluntary marketing program, where they deliver grain just once a year. The flexibility of payment options assists the grower in managing expenses over a longer term.

LEADERSHIP

Arkansas Rice Research and Promotion Board



Mission:

“The Arkansas Rice Research and Promotion Board (RRPB), was established in 1985 to improve the profitability of growing rice in Arkansas by conducting a program of research, extension, and market development.”

Program Details:

Under the check-off program, rice growers contribute **1.35 cents** per bushel for rice research and the first buyer of rice contributes **1.35 cents** per bushel for promotion and market development efforts.

The program provides approximately **\$2.5 million to \$3 million** annually for research efforts conducted by the University of Arkansas System Division of Agriculture.

This check-off money funds research at the RREC and pays salaries at the Rice Research Verification Program, and enables the publication of grower education materials.

Research projects at the University of Arkansas are reviewed annually by the RRPB and new proposals are considered each year. The USA Rice Council has been chosen as the main representative of the Arkansas rice industry in the global marketplace.

Additional Funding:

In 2016, **tariff rate quota (TRQ) funds** were allocated to the RREC by the Rice Research and Promotion Board to benefit the rice breeding program, as well as several other programs. TRQ funds are intended for use as one-time emergency research funds. The 2016 allotment will be used by the RREC to supplement check-off research dollars in developing varieties tolerant to high nighttime temperatures that decreased 2016 rice yields. The RRPB is a key leadership organization that has proven its loyalty and dedication to meeting grower needs.



RRPB Leadership Structure
The Arkansas Rice Research and Promotion Board consists of nine rice growers nominated by industry organizations and appointed by the governor

An example of stakeholder collaboration is highlighted in this press release from the 2017 Arkansas Rice Expo

Stakeholders Collaborate for the Good of the Industry

Arkansas Rice Expo - Home Grown, World Famous

Aug 04, 2017

STUTT GART, AR -- The University of Arkansas held its annual rice expo and field day here today, and USA Rice staff joined several hundred rice farmers and industry members to highlight research, discuss industry issues, and to celebrate everything rice just before harvest begins in the area.

In addition to field tours, the expo featured a trade show and research seminars showcasing the latest rice products and varieties. The keynote address was delivered by former U.S. Congressman Charlie Stenhom of Texas who discussed the many challenges in passing a new farm bill and balancing the federal budget.

The Arkansas Rice Research and Promotion Board also met yesterday, and USA Rice President & CEO Betsy Ward provided updates on USA Rice domestic and international activities, and talked about some of the new players in key positions in Washington, DC.

"The expo had a great turnout this year," said Arkansas Rice Federation Chairman Jeff Rutledge. "This speaks volumes about the quality of the programming and research done by the University of Arkansas."

[Source: USA Rice-Arkansas Rice Expo](#)



Roll the Rice Dice



Research & Varietal Development

Breeding Program Details

“In rice breeding, improved quality is just as important as increased yield.” – Karen Moldenhauer, UA Rice Breeder

UA Rice Breeding Program Quick Stats



Breeding Goals

- Increased yield potential
- Increased quality: low chalk, acceptable cooking qualities, nighttime temperature resistance
- Improved processing characteristics
- Disease resistance
- Earliness
- Strong straw

- Established in the 1930s
- Developed 40+ improved rice varieties
- Partnership with AR Rice Research and Promotion Board since 1980
- Program includes breeding for medium grain, long grain, hybrid grain varieties
- 1,000 acre breeding facility is located in Stuttgart, AR
- 30% of rice grown in Arkansas developed by the UA breeding program

Partnerships Fuel the Breeding Program's Success

Industry

- **Riceland Grain Testing Partnership** allows for data collection based on milling and marketability during varietal development
- **Kellogg's Approved Varieties List** sends a signal to growers about which varieties to order from the RREC, based on industry demand

Growers

- **Rice Research Verification Program** assists growers in implementing best practices with UA varieties and provides verification of varieties to other growers of UA variety efficacy. This program allows for grower training, which increases the success of UA varieties in the market
- **DD50 Computerized Rice Management Program** assists growers with 26 management decisions based on growth stage (herbicide application, critical timing for insect and disease spraying, and N application). DD50 provides growers with valuable information to successfully grow new UA varieties. Growers feed information to the DD50 program, allowing breeders to continue to collect and update data on released varieties grown under on-farm conditions

Extension

- **Breeders, agronomists, pathologists, entomologists, ag engineers, ag economists** at UA work together for the successful release of new UA varieties and the development of sustainable production practices. Extension is the key to sustainably and effectively communicating research information at the farm level

SOURCE: University of Arkansas Foundation Seed Catalogue, University of Arkansas Extension Publication

Stage Gate Process – Breeding to Seed Deployment

8-year breeding process from cross to release:

	Breeding Phase		Varietal Testing Stage	Details	Location of Phase	
Year 1-2	Genetic Crossing (F1 & F2)		Greenhouse and In-Field Crossing	Continuous selections occur throughout the entire breeding timeline	RREC in Stuttgart, AR and three on-farm locations	
Year 2-4	Selections (F3 & F4 selections of trialed varieties kept each year)		Selection, including grain quality	Data collected on variety's marketability and mill ability in breeding year two and three at Riceland. On-farm testing staged for insect and disease resistance	Riceland in Stuttgart, AR & 2-3 research farm sites	
Year 4-8	Continual selection and inbreeding	Seed increases (Breeder to Foundation)	Variety Trials	Arkansas Performance Trials	Conducted by RREC breeding program. From here, lines may advance to regional trials for comparison against commercially released lines	Five locations in Arkansas (on-farm and at research stations)
				Advanced Regional Trials	Lines are tested in 5 states after advancing through AR Performance Trials	Uniform Regional Rice Nursery (AR, LA, MS, MO, TX)
				Multiplication	Three year process from breeder seed to foundation seed	RREC in Stuttgart, AR
Year 9	Foundation Seed Available to Certified Seed Companies and Growers					



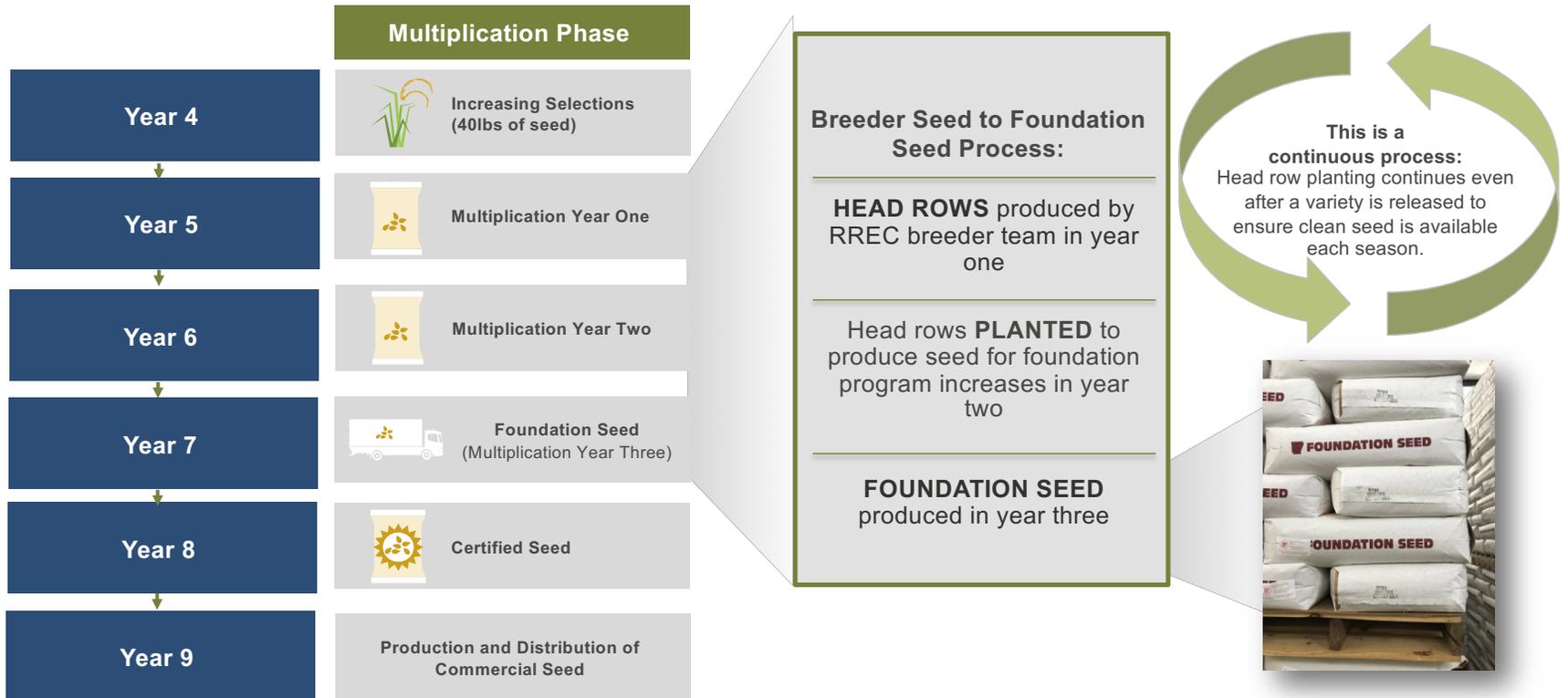
The University of Arkansas rice breeding program utilizes state-of-the-art equipment in collecting data to inform varietal selections



Cooking tests conducted at Riceland offer insights into important marketing characteristics of new rice varieties

Seed Multiplication Timeline

5-year process from Breeder Seed to Commercial Seed:



Public Varietal Release Descriptions

Varietal description for “Diamond” – a high-yielding long-grain rice variety released by the University of Arkansas

Varietal descriptions are published on the Rice Research & Extension Center’s Website



—————Diamond Variety Details—————

Diamond rice is a very high yielding, very short-season, long-grain rice developed at the Division of Agriculture's Rice Research and Extension Center in Stuttgart, Arkansas. Diamond is close in maturity to Lakast™ and about 4 to 5 days earlier than the Roy J varietal. Diamond has straw strength of 3 (equal to Wells), compared to a 4 for LaKast and 1 for Roy J. Diamond is 104 cm in plant height which is similar to Roy J and Wells. Rough rice grain yields of Diamond have consistently ranked as one of the highest in the Arkansas Rice Performance Trials

Diamond is rated S to sheath blight, blast, stem rot and kernel smut, which compares to Francis, Roy J, and Wells. Diamond is rated MS to bacterial panicle blight and lodging and VS to false smut using the standard disease R = resistant, MR = moderately resistant, MS = moderately susceptible, S = susceptible and VS = very susceptible to disease. Plants of Diamond have erect culms, green erect leaves, and glabrous lemma, palea, and leaf blades. The lemma and palea are straw colored with purple apiculi, many of which fade to straw at maturity.

The endosperm of Diamond is non-glutinous, non-aromatic, and covered by a light brown pericarp. Milled kernels of Diamond are long at 7.15 mm compared to Lakast, Roy J, Wells, Taggart and Mermentau at 7.47, 7.24, 7.16, 7.40 and 7.06 mm, respectively. Rice quality parameters indicate that Diamond has typical southern U.S. long-grain rice cooking quality. Diamond has an average apparent starch amylose content of 22.8 g kg⁻¹ and an intermediate gelatinization temperature (70 - 75 degrees C), as indicated by an average alkali spreading reaction of 3 to 5.



Demand Planning and Operations

KEY SUCCESS FACTORS

Demand Planning and Operations



Foundation Seed Production is Conservatively Managed to Mitigate Over-Production Risk

The Arkansas Foundation Seed (AFS) program bases its foundation seed demand forecast on pre-orders, plus an estimate for in-season orders. To mitigate overage costs associated with holding inventory over for another season, demand forecasts are pragmatic. Demand for AFS produced foundation seed normally surpasses supply.



Foundation Seed Scarcity Encourages Seed Growers to Pre-Order and Be Consistent Buyers

Seed growers pre-order foundation seed because it is a necessary input of their business and stock-outs are expected. To manage scenarios where supply does not meet demand, customers can achieve *Priority Customer* standing through consistent early ordering of foundation seed, which gives them priority in getting their seed orders filled.



Ethical Co-opitition Among Seed Companies Increases Market Insight and Reduces the Risk of Building Inventory of Un-Preferred Varieties

Seed companies compete for certified seed sales, but have a shared interest in the growth of the Arkansas rice industry. They collaborate on issues of mutual importance and advocate for companies' interests through the Arkansas Seed Dealers Association, which is led by seed company executives. Regional seed companies are critical enablers of the seed system, and rely on each other to execute their businesses. For example, when a seed company is short of seed, they reach out to other seed companies to satisfy their requirements. Cooperation between competitors also allows for enhanced coordination around product life cycles and demand planning. Communication between companies allows for phasing out of un-preferred varieties, as well as allocation of resources to ensuring adequate supplies of and support for new and existing varieties.



Public Sector Receives Input From the Private Sector on Grain Traits, Which Improves the Success of New Varieties

The public and private sectors collaborate to evaluate and screen research lines for traits that increase the profitability of commercial rice production (e.g., yield, stability, and disease tolerance). The public sector leverages private sector feedback on field performance trials and grain testing to increase the efficiency of its resource allocation, and improve the commercial adoption of new varieties.



Introduction of Hybrid Rice Put Pressure on Public Sector to Develop its Own Hybrid Rice Breeding Program

The introduction of hybrid rice in Arkansas by RiceTec in the early 2000s disrupted the rice seed industry. For many Arkansas rice farmers, the higher yield potential of hybrid rice seed was worth the increased seed costs compared to conventionally bred public varieties. The commercial success of hybrid rice, which is evidenced by its planting on approximately 40% of Arkansas rice acres in 2017, led Arkansas rice growers to fund a public hybrid rice breeding program at the Rice Research & Extension Center in order to develop lower cost, public sector alternatives. This is evidence of the pride, loyalty, and ownership that Arkansas growers have in and for the University of Arkansas breeding program.

Early Generation Seed Deployment Model

	Breeder Seed	Foundation Seed	Certified Seed	Commercialization
Who	UA Division of Agriculture Arkansas Rice Research and Extension Center (RREC)	UA Division of Agriculture The Arkansas Foundation Seed(AFS) Program	Independent Growers on Contract Basis with Certified Seed Companies Arkansas Seed Dealers Association	Independent Growers Purchase seed from certified seed growers
Sector	 Public	 Public	 Private	 Private
Input	45-90 lb. Pre-Breeder Seed	40-200 lbs. Breeder Seed	2,000 lb. Foundation Seed	100,000 lb. Certified Seed
Output	40-200 lb. Breeder Seed 	2,000 lb. Foundation Seed 	100,000 lb. Certified Seed 	239 million bushels of Commercial Rice 
Capital Sources	<ul style="list-style-type: none"> • University Funding • Grants • Special Projects • Arkansas Rice Research & Promotion Board 	<ul style="list-style-type: none"> • Foundation seed sales cover variable costs • Labor cost covered by University • Arkansas Rice Research & Promotion Board supports special projects 	<ul style="list-style-type: none"> • Certified seed sales • NOTE: Certified seed dealers pre-order foundation seed from RREC with 50% payment due at time of purchase 	<ul style="list-style-type: none"> • Commercial seed sales • NOTE: Arkansas Rice Research and Promotion Board collects an assessment to fund research and marketing activities

Source: (1) USDA NASS

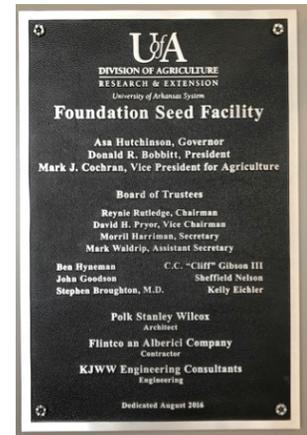
Arkansas Foundation Seed Program

OPERATIONS

Located at the Rice Research and Extension Center in Stuttgart, Arkansas, the Foundation Seed Facility opened in 2016 to replace a facility dating back to the 1950s.

This state-of-the-art facility manages the certified foundation seed produced by the University of Arkansas System Division of Agriculture. All foundation seed is inspected throughout the entire process, from the field to the point of sale, to ensure high quality and purity.

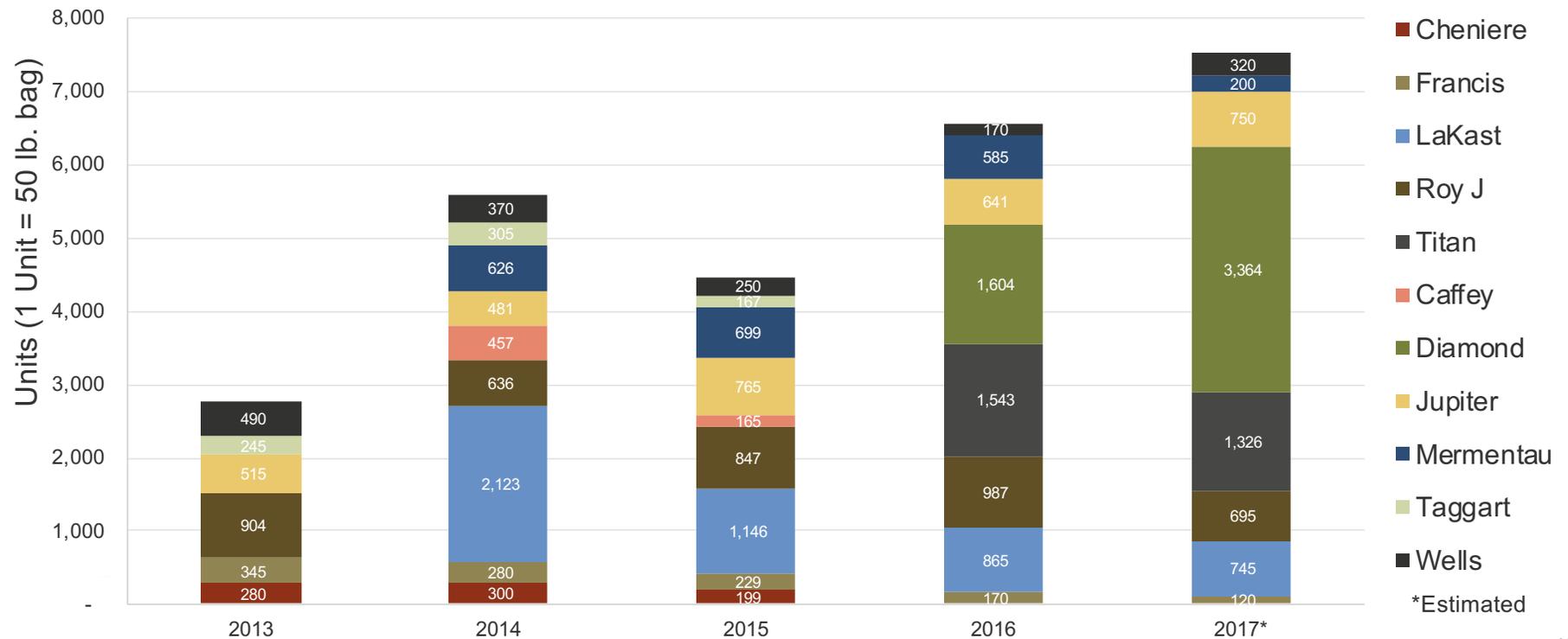
The facility can process as much as 250 bushels of seed an hour, including pre-cleaning, cleaning, sizing and bagging and has capacity to handle more than 25 varieties of seed each year. In addition to rice seed production, the facility also produces foundation seed for soybeans and wheat. – [Rice Research and Extension Center](#)



*2017 is an estimate

Rice Foundation Seed Sales by Variety (2013-2017)

THE PRODUCT LIFECYCLE OF A NEW RICE VARIETY RANGES FROM 3-10+ YEARS

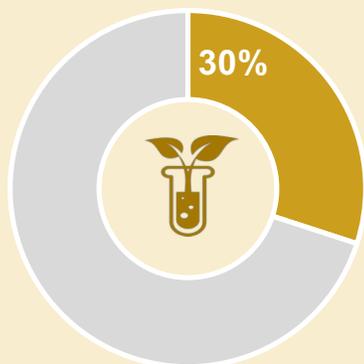




Financial Sustainability

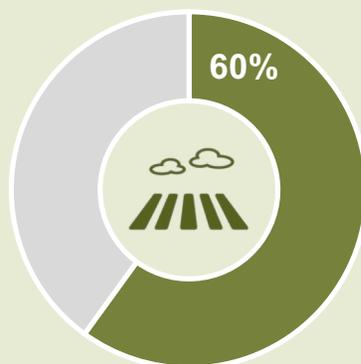
Financial Sustainability by EGS Value-Chain Step

Varietal Development & Breeder Seed Management



Public Sector Contributes 70% of Operating Costs; Grower-Led Commodity Association Funds the Other 30%

Foundation Seed Production



Public Sector Subsidizes 40% of Operating Costs; Seed Growers Fund 60% Through Foundation Seed Purchases

Certified Seed Production



Commercial Seed Companies Fund Certified Seed Production Through Seed Sales

Operational Costs For Foundation Seed Production and Processing (Rice, Soybean, and Wheat)¹



RICE IS ONE OF THREE CROPS THAT THE UNIVERSITY OF ARKANSAS PRODUCES FOUNDATION SEED FOR

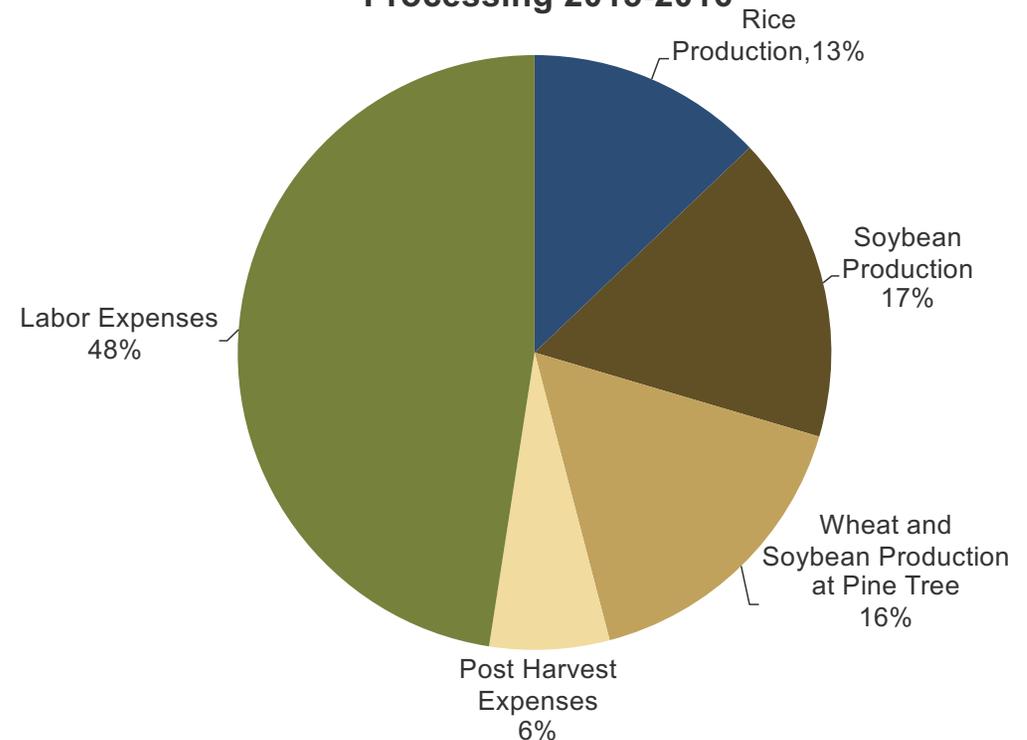


OVERHEAD COSTS ARE ALLOCATED ACROSS THE THREE CROPS, REDUCING THE FIXED COST BURDEN ON ANY INDIVIDUAL CROP



LABOR COSTS REPRESENT NEARLY HALF OF FOUNDATION SEED PRODUCTION & PROCESSING EXPENSES

Expenses for Foundation Seed Production and Processing 2015-2016



Sample Production Costs for Foundation Rice Seed Production¹

PUBLIC SECTOR PRODUCES 50lb BAGS OF FOUNDATION RICE SEED FOR \$57*, AND SELLS NEW VARIETIES FOR \$45

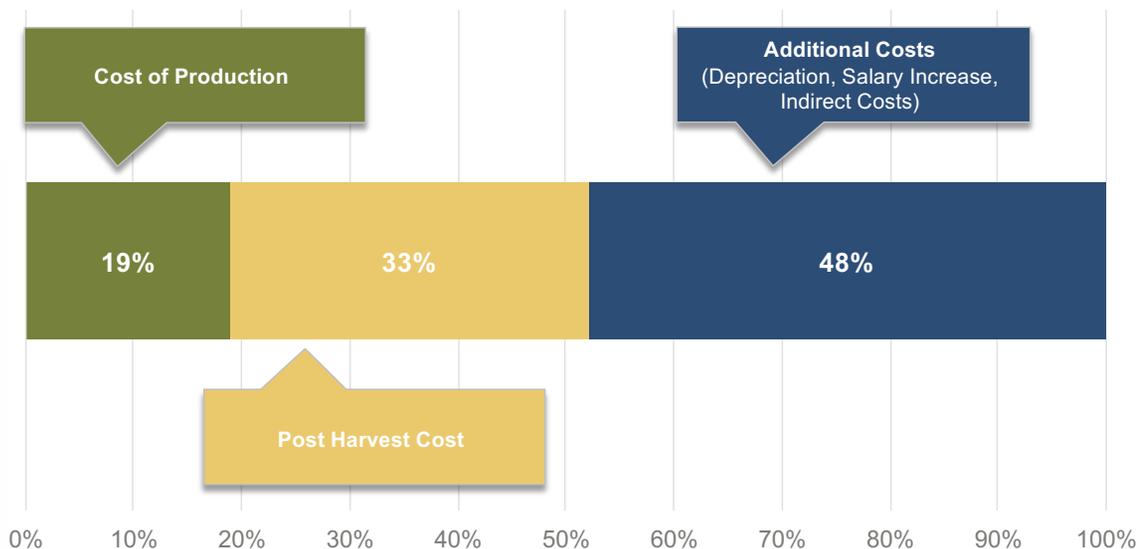
FOUNDATION RICE SEED PRODUCTION COSTS ON 50LB BAGS



Foundation Seed Facility Storage Area



Branded 50lb Bag of Foundation Seed



The transfer price of breeder seed in this analysis does not cover the cost of varietal development. Prices are indexed to 2016 prices.

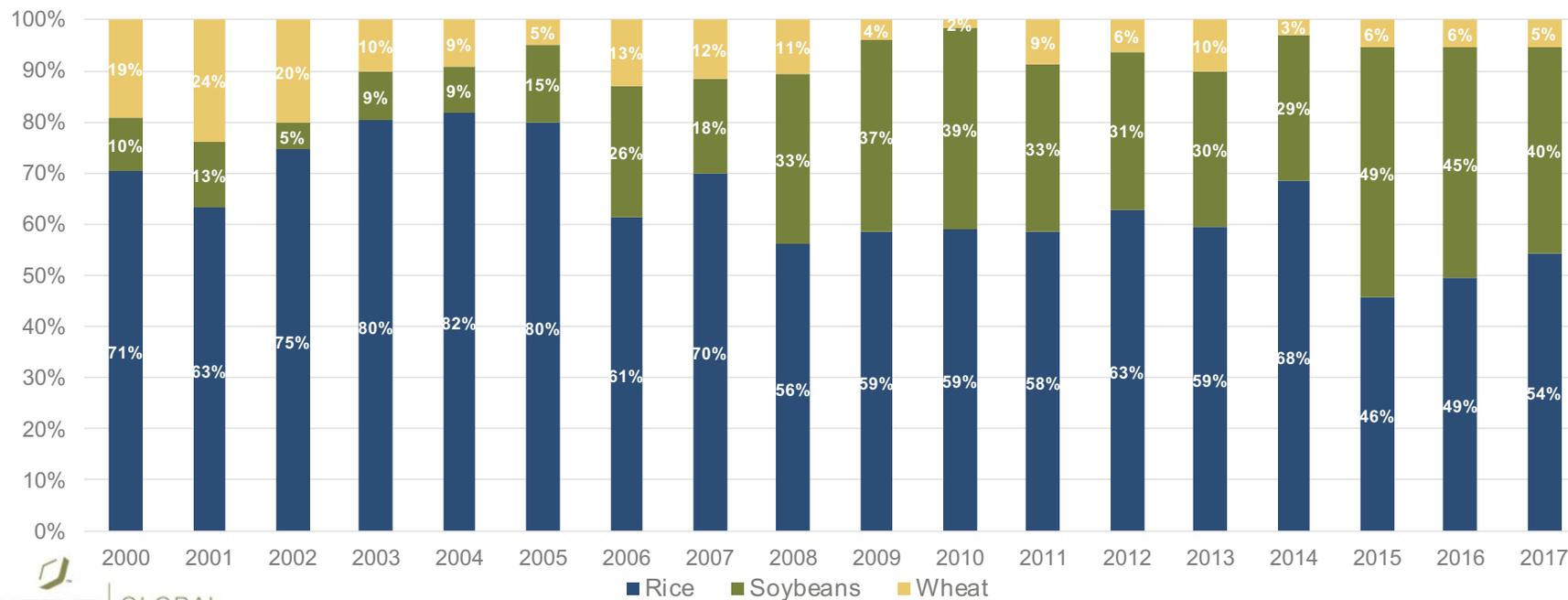
(1) Mane, R. and Watkins, K. 2016. Economic Analysis of the University of Arkansas System Division of Agriculture Rice Foundation Seed Program: Cost and Price. AAES Research Series 643.
*Only direct costs considered in total seed cost estimation

Arkansas Foundation Seed Program Revenue By Crop (2000-2017)¹

**RICE CONTRIBUTES THE LARGEST
SHARE OF RREC FOUNDATION SEED
REVENUE**

**INTRODUCTION OF HYBRID RICE IN 2005
LED TO A DECLINE IN RICE FOUNDATION
SEED REVENUE**

**CONTINUED INTRODUCTION OF NEW &
IMPROVED CONVENTIONAL RICE
VARIETIES ENABLES COMPETITION
AGAINST HYBRID OFFERINGS**

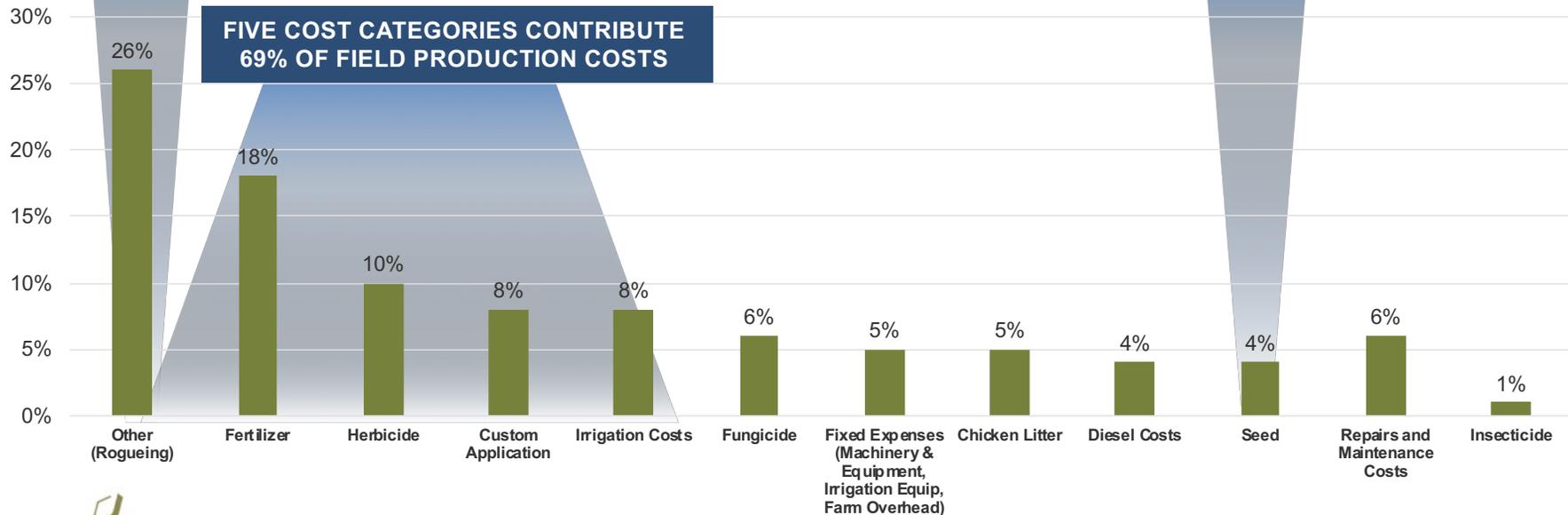


(1) Mane, R. and Watkins, K. 2016. Economic Analysis of the University of Arkansas System Division of Agriculture Rice Foundation Seed Program: Cost and Price. AAES Research Series 643.

Foundation Seed Field Production Costs¹

ROGUEING REPRESENTS OVER
25% OF FIELD PRODUCTION COSTS

THE ARKANSAS FOUNDATION SEED PROGRAM DOES NOT
PAY A TRANSFER FEE FOR BREEDER SEED, WHICH REDUCES
ITS COST OF GOODS SOLD AND UNDERREPRESENTS THE
VALUE OF THIS NECESSARY INPUT



(1) Mane, R. and Watkins, K. 2016. Economic Analysis of the University of Arkansas System Division of Agriculture Rice Foundation Seed Program: Cost and Price. AAES Research Series 643.



Enabling Environment

ENABLING ENVIRONMENT

University Extension Provides Clear Agronomic & Economic Guidance to Arkansas Rice Farmers



2018

Rice Farming for Profit



Authors:

- Jarrold Hardke, Agronomy
- Ron Baker, Verification
- Tom Barber, Weed Science
- Nick Bateman, Entomology
- Mike Hamilton, Irrigation
- Chris Henry, Irrigation
- Gus Lorenz, Entomology
- Ralph Mazzanti, Verification
- Richard Norman, Soil Fertility
- Jason Norsworthy, Weed Science
- Trent Roberts, Soil Fertility
- Bob Scott, Weed Science
- Nathan Slaton, Soil Fertility
- Yeshi Wamishe, Plant Pathology

U of A Research & Extension supports rice growers on key production decisions, including: cultivar selection, planting timing, seeding rates, row spacing, irrigation, pesticide application, irrigation, drain timing, and harvest.

Cultivar Recommendations

2018 Recommended Rice Cultivars for Arkansas

Based on multiple years of advanced yield testing, below are the recommended rice cultivars for planting in 2018. Just because a cultivar is not listed does not mean it cannot be grown successfully, but testing indicates the cultivars listed to be the highest and most consistent performers in grain yield and milling yield across a wide range of environmental and management conditions.

Conventional Long Grain Varieties	Conventional Long Grain Hybrids	Clearfield Long Grain Varieties	Clearfield Long Grain Hybrids	Conventional Medium Grain Varieties
Diamond	RT XP753	CL151	RT Gemini 214 CL	Jupiter
LaKast	RT XP760	CL153	RT CLXL745	Titan ²
Roy J		CL172	RT 7311 CL	

¹ Titan has not yet received full market approval. However, it has been the highest yielding medium-grain cultivar in performance testing. Consider establishing a buyer prior to growing Titan.

Grain yield and milling yield results for Arkansas Rice Performance Trials (ARPT) and Producer Rice Evaluation Program (PREP) on-farm trials, 2015-2017.

Cultivar	Grain Type	Days to Hg	Log ₁₀ Png Rating	% Head Rice - % Total Rice			Grain Yield Bushels per Acre				
				2015	2016	2017	MEAN	2015	2016	2017	MEAN
CL151	L	81	S	61.70	54.70	59.70	58.70	172	179	197	183
CL153	L	84	MR	61.70	57.70	61.71	60.70	170	181	192	181
CL172	L	84	MR	61.69	54.70	62.69	59.70	154	176	188	173
Diamond	L	84	MS	59.68	53.68	58.68	57.68	193	198	208	200
LaKast	L	81	S	57.69	52.70	58.70	56.70	183	194	200	189
Roy J	L	88	MR	60.70	54.70	60.71	58.70	175	189	195	186
RT 7311 CL	L	83	S	—	50.69	53.70	52.69	—	218	228	223
RT CLXL745	L	79	S	59.70	48.70	56.70	54.70	200	202	209	204
RT Gemini 214 CL	L	88	S	—	52.69	57.69	54.69	—	227	218	223
RT XP753	L	80	MS	56.69	46.68	53.70	51.68	223	236	231	230
RT XP760	L	85	S	59.69	52.69	57.69	56.69	212	217	219	216
Jupiter	M	85	S	61.68	56.68	61.70	59.69	167	194	207	189
Titan	M	80	MS	54.68	50.69	54.68	53.68	175	204	216	199

² For more information on cultivar performance and disease ratings visit the Extension at <http://www.uaex.edu/rice> under "Results of Arkansas Rice Cultivar Testing".

Forecasted Profitability

Total Net Return based on ARPT and PREP grain yield and milling yield results, 2015-2017, and production costs from Enterprise Budgets.

Cultivar	Grain Type	Avg Grain Yield	Avg Milling Yield	Production Cost ¹	Net Return (\$ per Acre) ²			MEAN
					2015	2016	2017	
CL151	L	183	58.70	\$ 657.35	\$ 279.87	\$ 304.72	\$ 412.58	\$ 332.39
CL153	L	181	60.70	\$ 657.35	\$ 270.42	\$ 324.34	\$ 396.14	\$ 330.30
CL172	L	173	59.70	\$ 657.35	\$ 179.52	\$ 287.92	\$ 365.57	\$ 277.67
Diamond	L	200	57.68	\$ 629.33	\$ 409.15	\$ 428.43	\$ 493.99	\$ 443.96
LaKast	L	189	56.70	\$ 629.33	\$ 352.87	\$ 351.62	\$ 453.68	\$ 386.06
Roy J	L	186	56.70	\$ 629.33	\$ 319.81	\$ 380.71	\$ 436.12	\$ 378.88
RT 7311 CL	L	223	52.69	\$ 730.57	—	\$ 418.87	\$ 488.38	\$ 453.62
RT CLXL745	L	204	54.70	\$ 730.57	\$ 353.29	\$ 334.91	\$ 395.67	\$ 361.29
RT Gemini 214 CL	L	223	54.69	\$ 730.57	—	\$ 473.89	\$ 442.89	\$ 458.39
RT XP753	L	230	51.69	\$ 778.49	\$ 416.27	\$ 451.29	\$ 458.22	\$ 441.93
RT XP760	L	216	56.69	\$ 778.49	\$ 363.34	\$ 369.02	\$ 401.69	\$ 378.02
Jupiter	M	189	59.69	\$ 629.33	\$ 269.44	\$ 405.15	\$ 493.98	\$ 389.52
Titan	M	199	53.68	\$ 629.33	\$ 298.73	\$ 444.72	\$ 520.34	\$ 421.26

¹ Production cost based on Total Specified Expenses in 2018 Crop Enterprise Budgets for Arkansas Field Crops Planted in 2018.

² Numbers based on current cash bid price minus basis of \$5.37 per bushel and corrected for milling yield based on long grain loan prices of \$4.50 for whole kernel and \$3.13 for broken and medium grain loan prices of \$4.27 for whole kernel and \$3.13 for broken.

It is highly recommended to relate the production costs to those on your own farm / fields to more accurately gauge potential economic returns for your operation. Adding any net return back to the production cost for that cultivar will give the total revenue - then you can subtract your production costs to better represent potential net return for your operation.

Planting Recommendations

Recommended Optimum Seeding Date for Rice by Geography

General optimum and absolute recommended seeding dates by geographic region in Arkansas are based on yield potential and management considerations.

Geographic Region	Optimum ¹		Recommended Absolute ²	
	Begin	Cut-off	Begin	Cut-off
North	April 10	May 10	April 1	June 5
Central	April 1	May 15	March 25	June 10
South	March 28	May 20	March 20	June 15

¹ Seeding during the optimum time frame does NOT guarantee high yields or suggest that crop failure cannot occur when rice is seeded during these times.

² Recommended absolute does NOT mean that a successful rice crop cannot be grown if seeded outside of the dates listed. Success may be evaluated and/or interpreted using various parameters (i.e. cropping system, cash flow, field reclamation, etc.) and may differ among specific cultivars.

Financial Enabling Environment

FUNCTION	DETAIL
 <p>National Commodity Price Hedge</p>	<p>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.</p>
 <p>Regional Commodity Price Hedge</p>	<p>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.</p>
 <p>Commodity Marketing Credit</p>	<p>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.</p>
 <p>National Crop Insurance</p>	<p>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.</p>

Source: [USDA ERS](#)



thank you



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



Mark Nelson
+1 607.592.4947

www.cgd.global
www.contextnet.com



ACKNOWLEDGEMENTS

Thank you for your time and support in the development of this Arkansas Rice EGS profile

Stakeholders Consulted

Name	Position	Organization
Dr. Glenn Bathke	Project/Program Director	Rice Research & Extension Center
John Carlin	Assistant Director	Arkansas Crop Variety Improvement Program
Jay Coker	Board Member, Rice Farmer	AR Rice Research and Promotion Board
Heath North	Director of Seed Operations	Stratton Seed Company
Michael Smith	VP Quality and Innovation	Riceland Foods
Dean Oliver	Director-Innovation and Technical Services	Riceland Foods
Dr. Karen Moldenhauer	Professor and Rice Breeder	University of Arkansas
Dr. Ehsan Shakiba	Asst. Professor and Rice Breeder	University of Arkansas
Dr. Xueyan Sha	Assoc. Professor and Rice Breeder	University of Arkansas

Research Spotlight: “Cultivar Development in the U.S. Public Sector” – Shelton, A. C., and W. F. Tracy. 2017

192 US-Based Plant Breeders Responded to a Survey in 2015 on Key Industry Questions



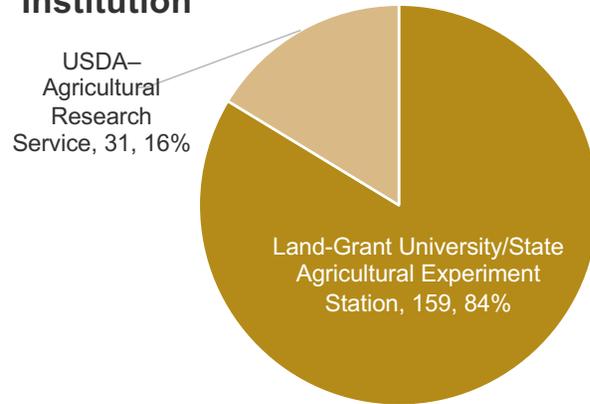
Abstract: Public plant breeders at land grant universities and USDA play a critical role in the development of improved cultivars for farmers in the United States. Over the past 20 yr, a series of reports have documented the decrease in public plant breeding programs, breeder positions, and government financial support. Publicly funded programs allow breeders to focus on crop types, geographic locations, and management systems that are not sufficiently profitable to warrant significant investment from private industry. A survey was conducted in 2015 to understand the current state of cultivar development in the U.S. public sector. The survey respondents were public plant breeders actively releasing finished cultivars and inbred lines, and questions included: (i) demographic and background information; (ii) germplasm usage and exchange; (iii) intellectual property rights; (iv) breeding program funding; (v) institutional support and program size. Results indicate that public cultivar development is in a state of decline, with insufficient numbers of younger breeders working in the public sector today to maintain the current level of cultivar development as the most senior breeders retire. Funding public breeding programs continues to be a challenge, as is access to improved germplasm due to overly restrictive licensing agreements. Potential opportunities include redistribution of royalty funds to bolster revenue streams, and simplifying the germplasm exchange process to increase the likelihood of successful cultivar releases.



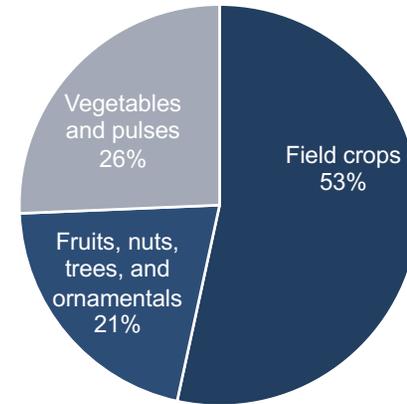
Conclusion: Public plant breeders play a critical role in determining the future of agriculture. Their work is varied, and includes long-term research in areas such as assessing and broadening genetic diversity, introgression of traits from wild species, development of new breeding methodologies, and expanding applications for genomic tools. Public plant breeders are responsible for the education of the next generation of plant breeders (both public and private), and require active breeding programs to provide hands-on learning for students, from initial crosses through the release process. In this study, we have focused on their role in cultivar development. Plant breeders in the public sector often focus on minor crops, cover crops, perennial crops, and geographies and farming systems that are under-served by the private sector. By improving these crops, regions and systems with well-adapted varieties, public plant breeders create a more resilient agricultural landscape that buffers against the increasing climactic and economic fluctuations of the 21st century. Yet plant breeding in the public sector is in a current state of crisis due to lack of sufficient funding to support this public good. In addition, the increasing use of restrictive IP limits public plant breeders' access to useful germplasm necessary for the development of improved cultivars. Public plant breeders have an opportunity to address this challenge by working with their universities and technology licensing offices, and one another to reduce the restrictive nature of their licensing agreements, especially for germplasm exchange with other public programs, and by redistributing royalty money allocations to increase support directly for cultivar development.

Public Plant Breeder Respondent Distribution by...

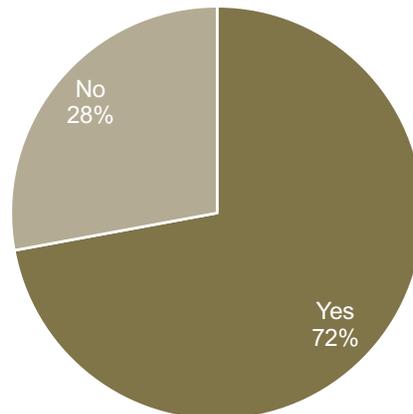
Institution



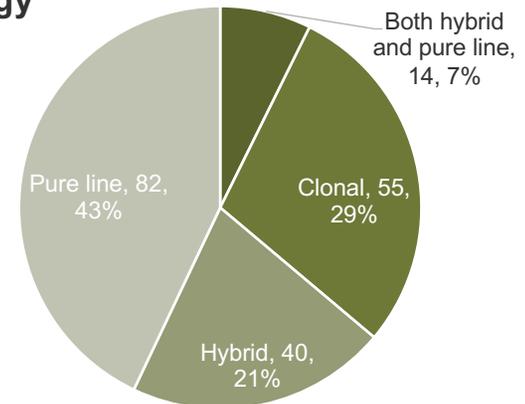
Crop Type



Tenure

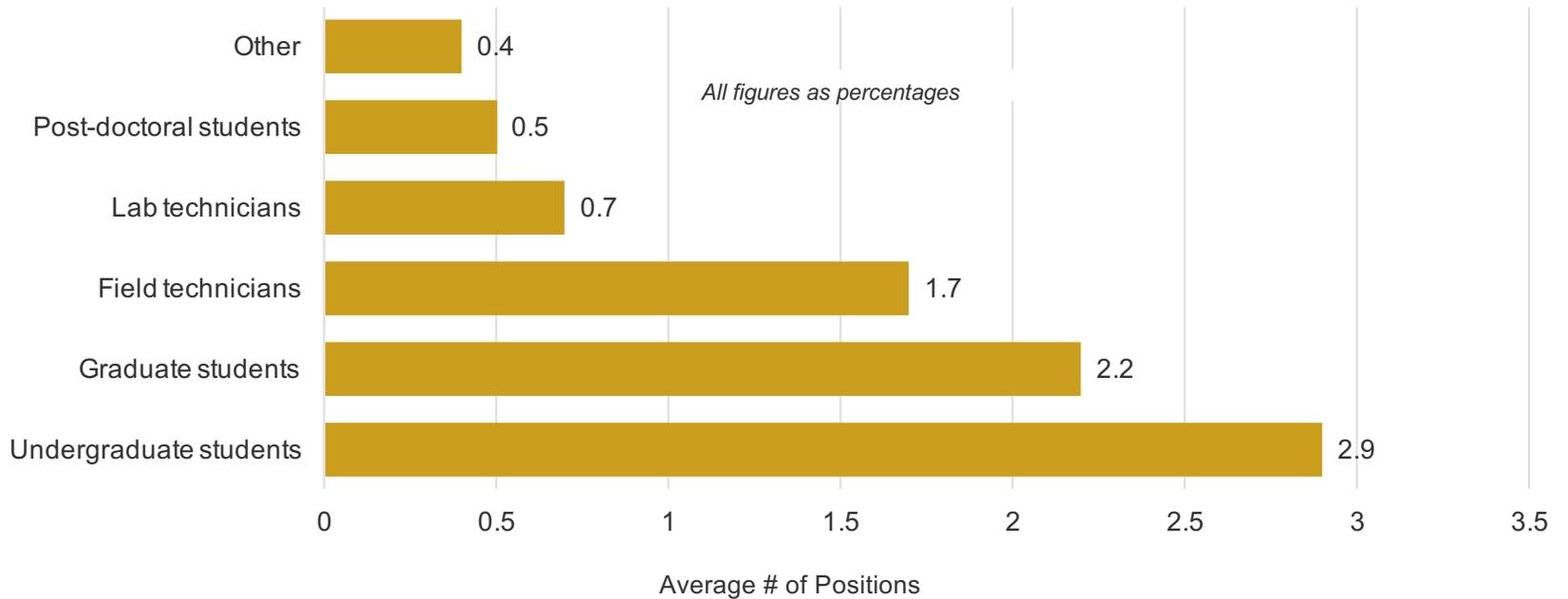


Crop Biology



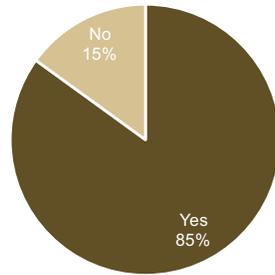
SOURCE: Shelton, A. C., and W. F. Tracy. 2017. Cultivar Development in the U.S. Public Sector. *Crop Sci.* 57:1823-1835. doi:10.2135/cropsci2016.11.0961

Breeders Report Employing an Average of 8.4 Persons

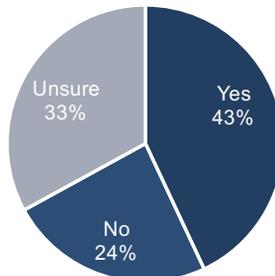


Breeding Programs Encourage and Incentivize Cultivar Development, But Only 43% of Breeders Report That Their Position Would Be Replaced if they Left

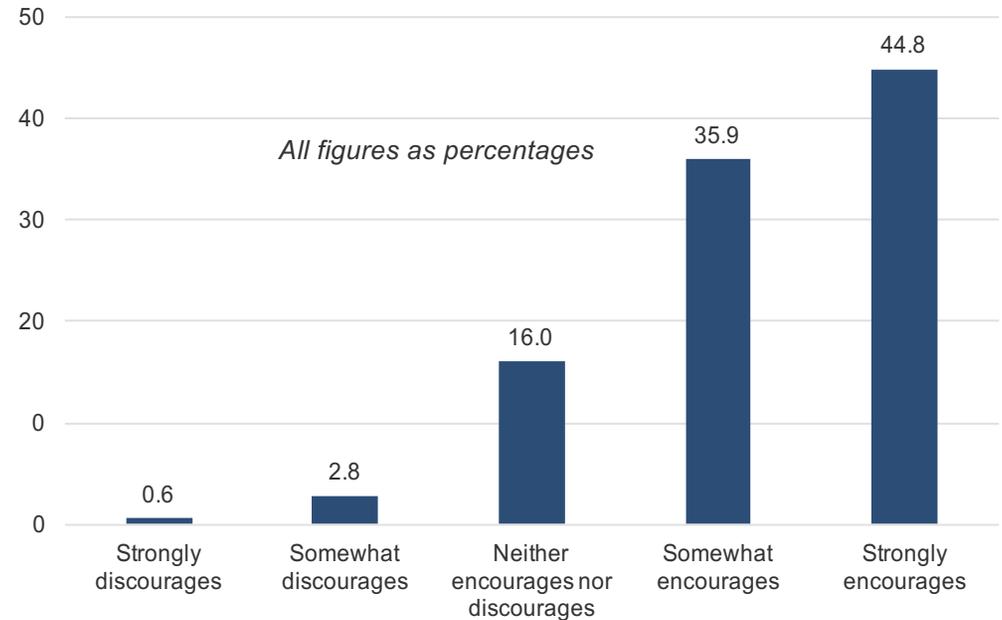
“If you work for an institution that offers tenure, does cultivar development count towards the tenure process?”



“If you were to leave your job for any reason, will your position be replaced?”

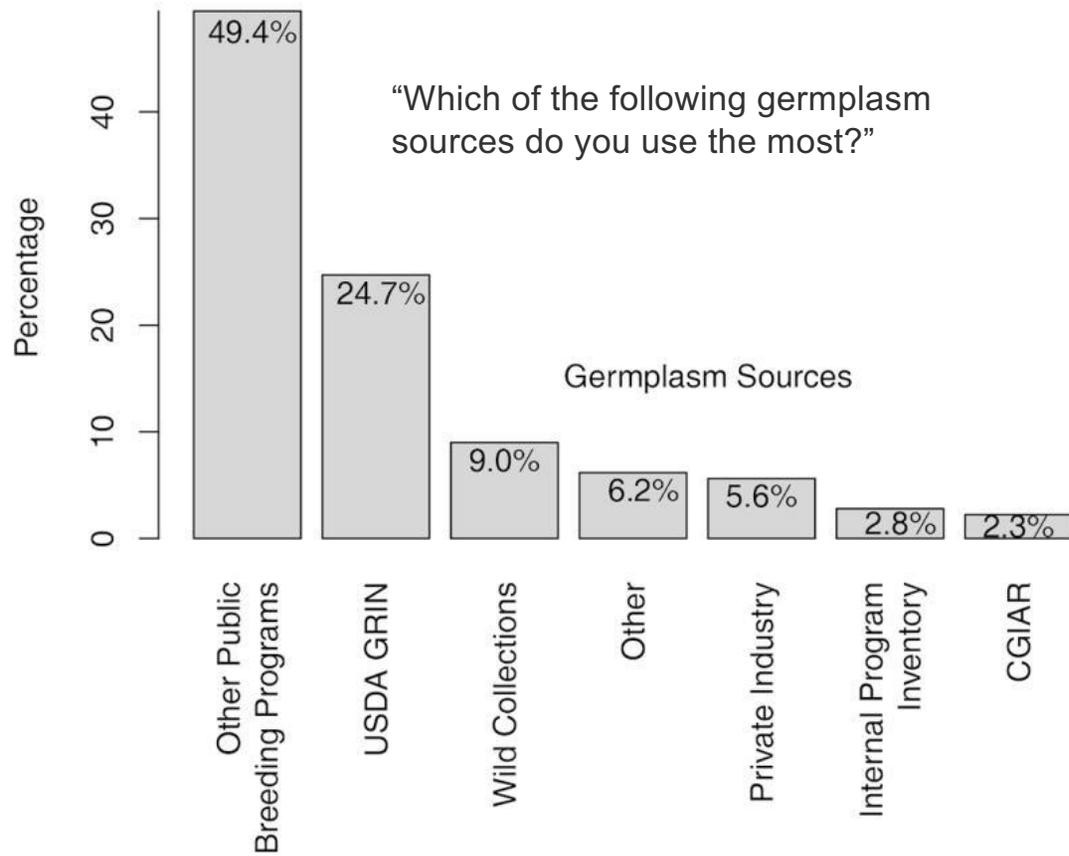


“How much does your institution encourage your cultivar development work?”



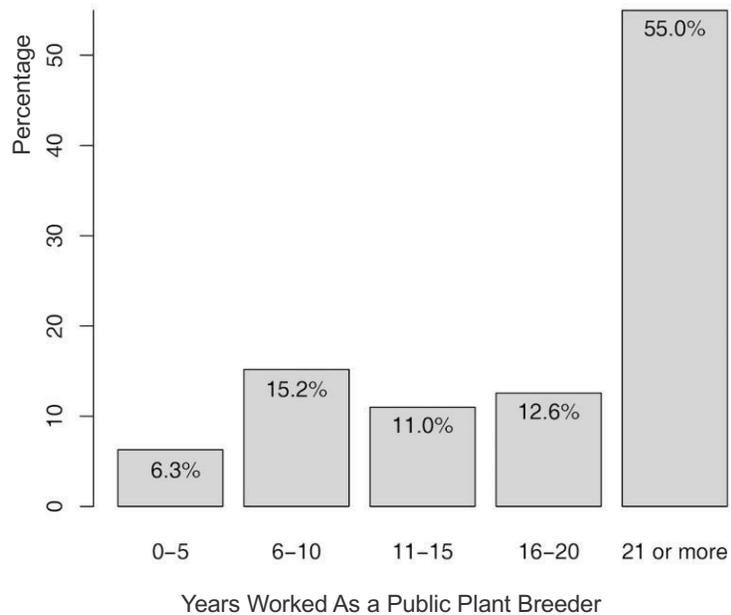
SOURCE: Shelton, A. C., and W. F. Tracy. 2017. Cultivar Development in the U.S. Public Sector. *Crop Sci.* 57:1823-1835. doi:10.2135/cropsci2016.11.0961

Breeders Most Commonly Source Germplasm From Other Public Breeding Programs

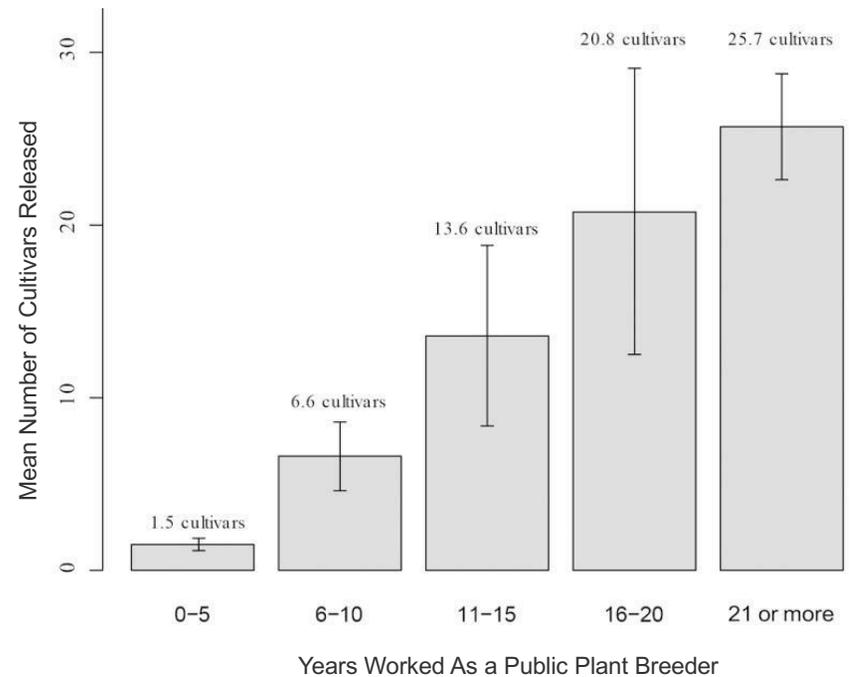


Positive Correlation Between Years Worked as a Public Plant Breeder and the Number of Cultivars Released

How many years have you worked as a plant breeder?



Number of cultivars released by number of years worked as a public plant breeder



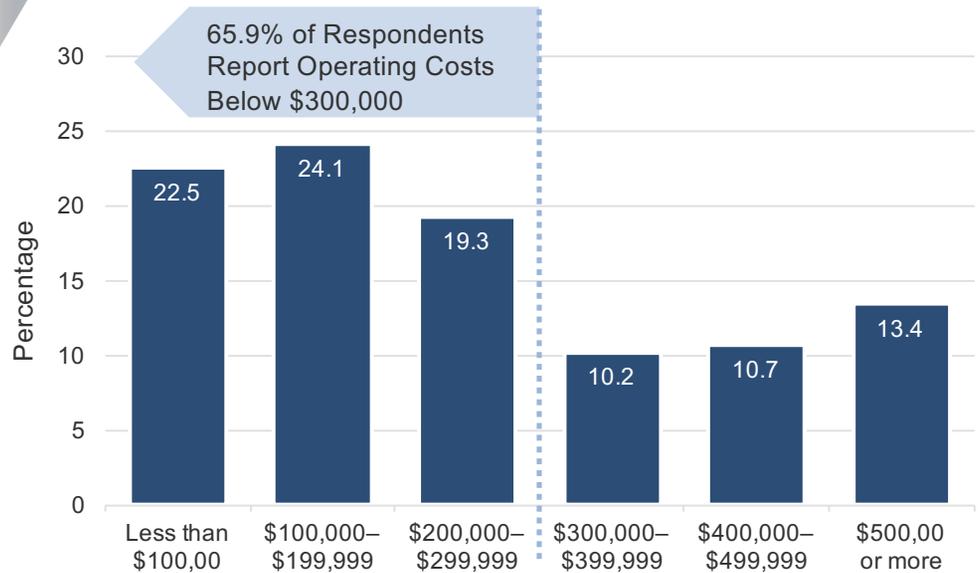
SOURCE: Shelton, A. C., and W. F. Tracy. 2017. Cultivar Development in the U.S. Public Sector. *Crop Sci.* 57:1823-1835. doi:10.2135/cropsci2016.11.0961

Breeders' Employers Contribute Less Than 25% of Annual Operating Costs

Funding Source	% of Breeding Program Funding
Employer	24.1
Commodity check-off programs	17.8
USDA competitive grants	14.2
Royalty money	12.3
Private industry	12.3
Federal formula funds	11.6
Other	7.6

Mean percentage distribution of funding sources for breeding programs based on public plant breeder respondents releasing finished cultivars (including inbred lines) and surveyed in 2015 (N = 177).

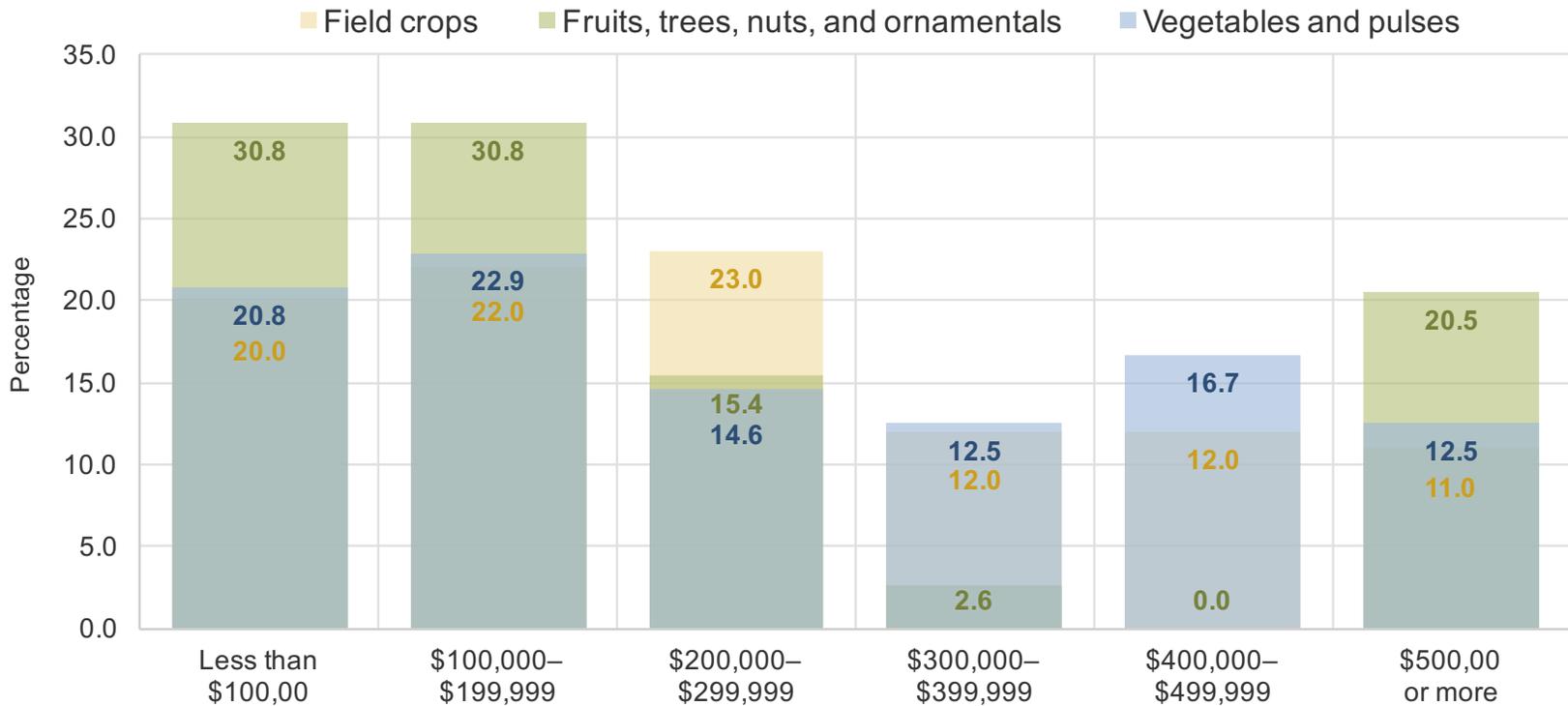
Distribution of Breeding Programs' by Annual Operating Costs



SOURCE: Shelton, A. C., and W. F. Tracy. 2017. Cultivar Development in the U.S. Public Sector. *Crop Sci.* 57:1823-1835. doi:10.2135/cropsci2016.11.0961

Regardless of Crop Type, Breeding Programs' Average Annual Operating Costs is Reported to be Below \$300K

Number of Respondents	
All	187
Field crops	100
Fruits, trees, nuts, and ornamentals	39
Vegetables and pulses	48



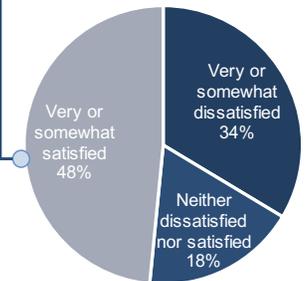
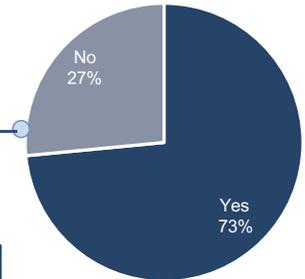
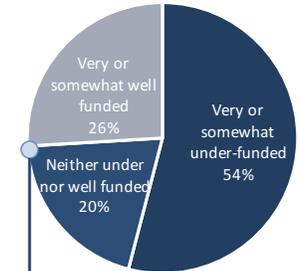
SOURCE: Shelton, A. C., and W. F. Tracy. 2017. Cultivar Development in the U.S. Public Sector. Crop Sci. 57:1823-1835. doi:10.2135/cropsci2016.11.0961

Majority of Respondents Indicate That Their Breeding Program is Under-Funded

Breeding Programs by Annual Operating Costs

All figures as percentages

	N	Less than \$100,00	\$100,00– \$199,999	\$200,000– \$299,999	\$300,000– \$399,999	\$400,000– \$499,999	\$500,000 or more
Do you feel your program is:							
Very or somewhat under-funded	100	34.0	30.0	17.0	10.0	4.0	5.0
Neither under nor well funded	37	13.5	27.0	18.9	8.1	16.2	16.2
Very or somewhat well funded	48	6.3	10.4	22.9	12.5	20.8	27.1
Does your program generate royalties?							
Yes	133	15.8	22.6	22.6	9.8	13.5	15.8
No	48	43.8	31.3	4.2	12.5	4.2	4.2
Satisfaction with royalty distribution:							
Very or somewhat dissatisfied	43	14.0	18.6	16.3	18.6	18.6	14.0
Neither dissatisfied nor satisfied	23	8.7	30.4	21.7	0.0	13.0	26.1
Very or somewhat satisfied	62	19.4	22.6	25.8	6.5	11.3	14.5



SOURCE: Shelton, A. C., and W. F. Tracy. 2017. Cultivar Development in the U.S. Public Sector. Crop Sci. 57:1823-1835. doi:10.2135/cropsci2016.11.0961

Respondent Responses Stratified by Their Breeding Programs' Reported Annual Operating Costs

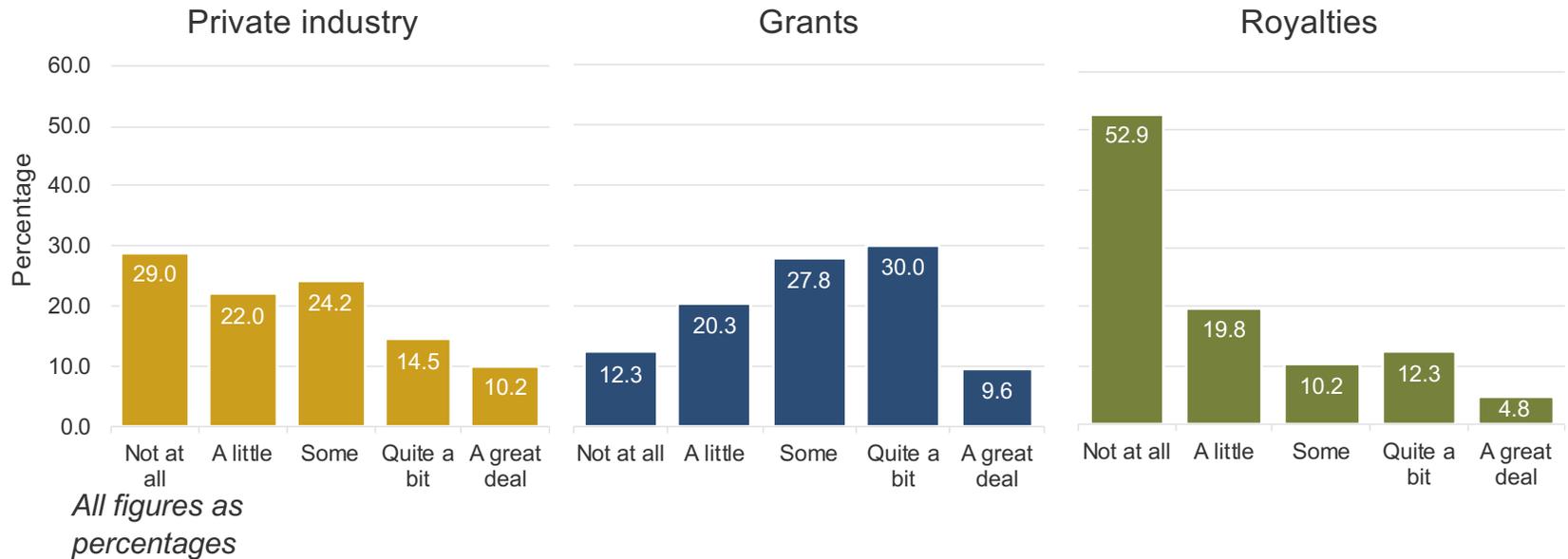
All figures as percentages

	N	Less than \$100,00	\$100,00–\$199,999	\$200,00–\$299,999	\$300,00–\$399,999	\$400,00–\$499,999	\$500,00 or more
Crop type							
All	187	22.5	24.1	19.3	10.2	10.7	13.4
Field crops	100	20.0	22.0	23.0	12.0	12.0	11.0
Fruits, trees, nuts, and ornamentals	39	30.8	30.8	15.4	2.6	0.0	20.5
Vegetables and pulses	48	20.8	22.9	14.6	12.5	16.7	12.5
Years worked as a public plant breeder							
0–5 yr	11	27.3	27.3	9.1	9.1	27.3	0.0
6–10 yr	28	25.0	14.3	39.3	10.7	0.0	10.7
11–15 yr	20	20.0	30.0	25.0	15.0	5.0	5.0
16–20 yr	24	20.8	41.7	12.5	8.3	8.3	8.3
21 yr or more	103	22.3	21.4	14.6	9.7	13.6	18.4
Do you feel your program is:							
Very or somewhat under-funded	100	34.0	30.0	17.0	10.0	4.0	5.0
Neither under nor well funded	37	13.5	27.0	18.9	8.1	16.2	16.2
Very or somewhat well funded	48	6.3	10.4	22.9	12.5	20.8	27.1
Does your program generate royalties?							
Yes	133	15.8	22.6	22.6	9.8	13.5	15.8
No	48	43.8	31.3	4.2	12.5	4.2	4.2
Satisfaction with royalty distribution:							
Very or somewhat dissatisfied	43	14.0	18.6	16.3	18.6	18.6	14.0
Neither dissatisfied nor satisfied	23	8.7	30.4	21.7	0.0	13.0	26.1
Very or somewhat satisfied	62	19.4	22.6	25.8	6.5	11.3	14.5
Will your position be replaced?							
Yes	77	9.1	13.0	23.4	14.3	15.6	24.7
No	43	41.9	25.6	9.3	11.6	2.3	9.3
Unsure	59	27.1	39.0	18.6	3.4	11.9	0.0

SOURCE: Shelton, A. C., and W. F. Tracy. 2017. Cultivar Development in the U.S. Public Sector. *Crop Sci.* 57:1823-1835. doi:10.2135/cropsci2016.11.0961

Respondents Believe Grants Have a Larger Influence on the Focus of Breeding Work Than Private Industry

Table 8. Impact of funding sources on focus of breeding work reported by public plant breeder respondents releasing finished cultivars (including inbred lines), and surveyed in 2015.

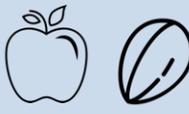


SOURCE: Shelton, A. C., and W. F. Tracy. 2017. Cultivar Development in the U.S. Public Sector. Crop Sci. 57:1823-1835. doi:10.2135/cropsci2016.11.0961

Intellectual Property Rights Are Routinely Secured on Public Breeders' Cultivars

Likelihood of usage of various forms of intellectual property rights to protect cultivars (including inbred lines) released by public plant breeder respondents and surveyed in 2015.

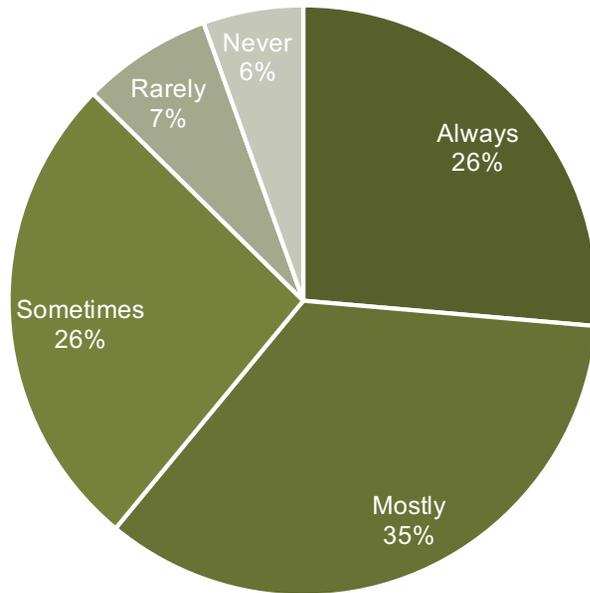
All figures as percentages

	Field crops	Fruits, nuts, trees, ornamentals	Vegetables and pulses
Form of intellectual property rights			
License	78.2	77.1	79.4
Plant variety protection certificate	85.4	34.4	85.3
Plant patent	12.5	86.5	9.7
Trademark	11.1	65.7	25.8
Utility patent	20.9	3.3	6.7

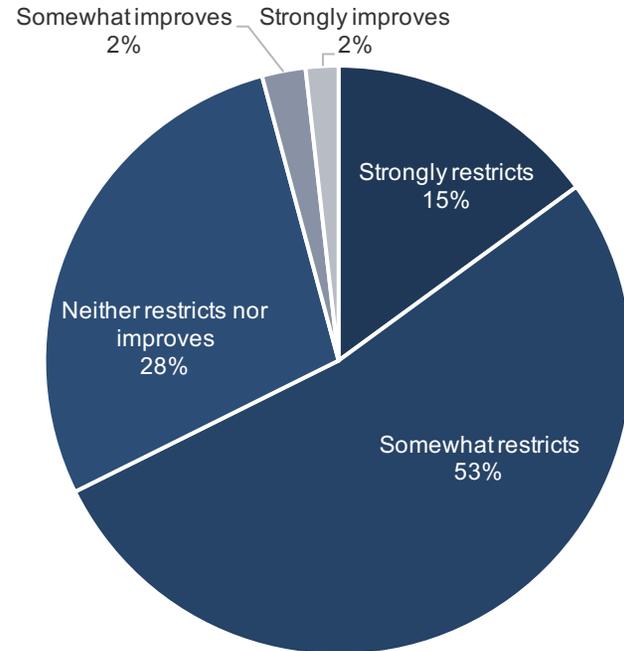
SOURCE: Shelton, A. C., and W. F. Tracy. 2017. Cultivar Development in the U.S. Public Sector. *Crop Sci.* 57:1823-1835. doi:10.2135/cropsci2016.11.0961

Breeders Commonly Share Germplasm (95%), but the Associated Material Transfer Agreements Restrict Breeders' Freedom to Operate

How do often does germplasm leave your institution with a material transfer agreement (MTA)?



How does the language of the MTA that you receive impact your freedom to operate as a plant breeder?



SOURCE: Shelton, A. C., and W. F. Tracy. 2017. Cultivar Development in the U.S. Public Sector. *Crop Sci.* 57:1823-1835. doi:10.2135/cropsci2016.11.0961