
STATE of ORGANIC
seed
2022

KRISTINA HUBBARD, JARED ZYSTRO, LIZA WOOD

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Please contact Kristina (Kiki) Hubbard at kiki@seedalliance.org with any questions or for more information about the report. Physical copies are available by donation.

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ORGANIC SEED ALLIANCE

Organic Seed Alliance is a 501(c)(3) nonprofit that advances ethical seed solutions to meet food and farming needs in a changing world. Our work ensures an abundant and diverse supply of ecologically grown seed, tended in perpetuity by skilled and diverse communities of seed stewards. To advance this mission, we serve growers working with seed across the US at any scale through participatory research, practical education, policy advocacy, and network development. We prioritize partnerships with organizations and individuals aligned with our values, and we convene spaces where divergent viewpoints can be expressed and explored. In all our work, we ally ourselves with and embrace opportunities to amplify movements for community sovereignty, racial equity, and social justice.

OSA's programs are woven of technical expertise, rigorous methods, practical experience, and deep reverence for seed work. We are in awe of the processes of life, and root our organizational systems in the wisdom of ecology. We continually seek input from growers working with seed, ensuring that we are directed by, and accountable to, the people we serve.

Each year, OSA educates thousands of farmers and other agricultural community members through on-farm and online events and resources. Our research program involves organic plant breeding and seed production research, and our advocacy efforts focus on policies that strengthen organic seed systems.

Over the last four decades, the seed industry has rapidly consolidated. Much of our commercial seed is now owned and managed by a small number of transnational firms. Intellectual property practices (e.g., utility patents on seed) stand out as a major cause. This control has stifled innovation in plant breeding and has created barriers to improving the availability and integrity of organic seed.

OSA works to address consolidation through regional seed networks that result in transformative change at the national level. Our collaborative research projects emphasize diversity, ecology, and shared benefits. Our educational efforts build the base of knowledge necessary for stewarding seed and enhancing diversity through on-farm plant breeding and seed production. And our policy advocacy work promotes the benefits of organic seed while simultaneously confronting threats to genetic integrity and growers' rights.

ACRONYMS

ACA Accredited Certifying Agent

AFRI Agriculture and Food Research Initiative

BIPOC Black, Indigenous, and People of Color

CGC Cooperative Gardens Commission

DOJ Department of Justice

GE Genetically engineered

GMO Genetically modified organism

IFOAM International Federation of Organic Agriculture Movements

IPR Intellectual property rights

NOP National Organic Program

NOSB National Organic Standards Board

OFRF Organic Farming Research Foundation

OREI Organic Agriculture Research and Extension Initiative

OSA Organic Seed Alliance

OSSI Open Source Seed Initiative

PVP Plant Variety Protection

SARE Sustainable Agriculture Research and Education

SESRC Social and Economic Sciences Research Center

SOS State of Organic Seed

USDA US Department of Agriculture

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Executive Summary

State of Organic Seed (SOS) is an ongoing project to monitor organic seed systems in the United States. Every five years, Organic Seed Alliance (OSA) releases this progress report and action plan for increasing the organic seed supply while fostering seed grower networks and policies that aim to decentralize power and ownership in seed systems. This 2022 report is our third update, allowing us to compare new data with our 2011 and 2016 findings.

The data comparisons included in this report provide a snapshot of progress (or lack thereof) and ongoing challenges and needs for expanding organic seed systems and the seed supply they support. More than ever, organic seed is viewed as the foundation of organic integrity and as an essential component to furthering the principles underpinning the organic movement. The authors of this report view organic agriculture as more than a package of production practices, but as a necessary social movement that can create a sustainable and equitable path for our seed, food, and farming systems.

The organic seed supply has grown tremendously since the National Organic Program (NOP) was established in 2002, which formalized the US organic standards. Certified organic growers are required to source organic seed when commercially available, but our findings show that most organic growers still plant some non-organic seed for at least part (if not all) of their operations. Unfortunately, our newest findings show no meaningful improvement in organic seed usage since our 2016 report.

Our newest findings show no meaningful improvement in organic producers using more organic seed.

We arrived at this and other conclusions through a number of data collection methods. SOS is drawn from seven data sets: four different surveys of organic growers, certifiers, researchers, and seed producers/companies; seed producer interviews; a database of organic research project funding; and grower focus groups organized by Organic Farming Research Foundation (OFRF). New to this report is a deeper examination of seed producer/company experiences and research needs, in addition to an analysis of their networks.

ORGANIC SEED AS A CATALYST FOR CHANGE

Seeds are alive and adapt to changing climates through seed saving, selection, and other classical plant-breeding techniques. This adaptation is key for a crop's survival—mitigating risks for growers and the communities they feed. Organic plant breeding and organic seed are therefore key elements of adaptable and resilient farming systems. When these seeds are grown organically, the climate benefits are even greater. For example, organic seed is produced without fossil fuel-based fertilizers, a major contributor of greenhouse gas emissions.

Organic seed provides other environmental and human health benefits as well. This is most evident when looking at the number and volume of chemical pesticides applied to farm fields—including conventional seed fields—each year that result in harm to non-target organisms, water and soil quality, and human health. Organic seeds are grown without synthetic chemicals and are not treated with synthetic chemical seed coatings, so growers who plant organic seed are choosing to keep pollution caused by synthetic pesticides out of our soils, water, air, and food.

We also believe that a healthy seed system is decentralized, with many decision makers at the table: seed growers/savers, plant breeders, farmers, consumers, chefs, food and seed businesses, Indigenous seed keepers and tribal nations, and others. In important ways, the expansion of organic seed systems has embraced decentralized approaches to plant breeding, seed production, and distribution. And as a social movement, we believe that organic seed can take a distinct path from the dominant conventional seed industry, where consolidation and privatization are key strategies. As the seed industry further concentrates ownership of seed, we see evidence that organic seed growers and their networks are striving to expand the organic seed supply through strategies of decentralized power and ownership to avoid the negative consequences of consolidation and privatization.

KEY FINDINGS

As mentioned, the organic standards require sourcing of organic seed when commercially available, but most organic producers are still using non-organic seed for at least part (if not all) of their operations. Some key findings include:

▶ Organic producers and their organic seed use

Vegetable producers who grow fewer than 50 acres of crops report using more organic seed. Much like we saw in our last report, the biggest vegetable producers still use relatively little organic seed, and this has a big impact on overall acres planted to organic seed.

Organic seed sourcing in field crops, forage crops, and cover crops remains stagnant. Approximately one third of these growers report increasing the percentage of the organic seed they're planting, and roughly 40 percent of producers report using about the same amount of organic seed compared to three years ago.

Producers report variety unavailability as their top reason for not sourcing organic seed. Furthermore, certifiers have a hard time identifying what might be substituted as an equivalent variety per the organic seed regulation.

We saw an increase in organic producers reporting a processor/buyer requirement as a factor in not sourcing organic seed. More than 30 percent of respondents identified this as a challenge, and some certifiers also report these processor/buyer requirements as barriers to organic seed sourcing.

Most organic producers source their seed directly from seed companies through websites, catalogs, and sales representatives. A much smaller percentage of organic producers source seed from their own production, stores, processors, buyers, or other farmers.

Organic producers still believe organic seed is important to the integrity of organic food and that varieties bred for organic production are important to the success of organic agriculture. These findings match our last report and demonstrate that growers understand that breeding crops in organic systems is important to their success and to that of the broader organic industry.

▶ Organic seed and breeding research and investments

Public investments in organic plant breeding and other organic seed research have increased by $39 million in the last five years alone. In our first report, we documented $9 million in investments between 1996 and 2010 and saw this increase to $22 million between 2011 and 2016. Our most recent finding demonstrates good progress toward funding this critical area of plant breeding to support organic seed systems and the organic growers who rely on them. Still, public investments in organic seed systems fall short in light of the growing demand for organic products.

The bulk of public research investments come from USDA OREI and are dedicated to breeding and variety trials. Multi-regional projects receive the most funding, as researchers across the country collaborate to support organic research.

More public plant breeders are having success releasing new organic varieties. Public plant-breeding programs help fill market gaps unmet by the private sector, including in organic seed, but more public investments are needed to ensure these programs remain viable and responsive to the needs of growers in their regions. Challenges include staffing and capacity for researchers to carry out their projects.

Our data indicates that organic seed priorities pursued by researchers generally align with the demands of organic producers. In particular, organic producers identified a number of vegetable and field crops as needing plant-breeding attention, and these are the most popular crop categories being researched—with disease resistance and yield traits taking priority.

Fewer producers report saving seed for either on-farm use or to sell commercially compared to our last report. A quarter of farmers are using saved seed, and nearly half are producing seed for on-farm use or to sell commercially. Despite a significant decrease in producers reporting saving and/or producing commercial seed, most farmers responding to our organic producer survey are interested in learning how to produce seed commercially. The lack of training, economic opportunity, and seed processing facilities were the top factors keeping farmers from growing organic seed commercially.

Fewer producers report that their certifiers are requesting they take extra measures to source more organic seed. This is an important finding, since our data also shows that when certifiers encourage producers to improve their organic seed sourcing, these organic producers indeed source more organic seed.

▶ Perspectives from organic seed producers/companies

Seed producers face a number of production and non-production challenges. The production challenges reported include estimating and achieving yields; controlling weed, pest, and disease pressure; and managing climatic effects. Outside of production, managing business activities and finding markets, developing infrastructure, and finding and retaining skilled labor all rank high on the list of challenges.

Climate change is severely impacting organic seed growers. Numerous growers reported extreme weather events and unpredictable changes in their climate as a serious challenge. Policy actions and research investments are needed to mitigate the impacts and increase the climate robustness of our crops and seed systems.

GMO contamination remains a concern of organic producers and seed companies. Maintaining high genetic integrity of organic/non-GMO seed used in organic farming is important to organic producers and seed producers/companies, but organic policy solutions are difficult to identify. True "coexistence" is only possible when manufacturers and users of GMO crops share the responsibility for preventing contamination of organic and other non-GE seed.

Seed producers/companies and organic researchers view utility patents on seed as the most harmful form of intellectual property right (IPR) associated with seed. They also viewed the Open Source Seed Initiative (OSSI) pledge as most helpful.

A major gap in data and resources is a reliable, national database of all commercially available organic varieties. A more robust organic seed database would support organic seed sourcing and enforcement of the organic seed requirement and could serve as a market assessment of commercial availability.

Seed producers identified common elements when asked to envision a resilient seed system. In particular, seed producers would like to see decentralized regional communities of seed growers that can work together to share knowledge, access markets, and maintain diverse, productive, and adapted seed.

The current structure of seed networks across the US mostly reflects a resilient seed system. However, regions other than the West are still small and developing, and resources along the supply chain could stand to be diversified.

All seed networks rely on the National Plant Germplasm System. Seed producers/companies access these public seed collections for purposes of adaptation, breeding, and seed production, underscoring the importance of ensuring adequate funding, access, and accountability within this system.

TOP RECOMMENDATIONS

A longer list of recommendations can be found in the conclusion of the report. We hope these recommendations will serve as an action plan for increasing the organic seed supply while fostering seed-grower networks and policies that aim to decentralize power and ownership in seed systems. The recommendations that stand out as most timely include:

- Public research investments in organic plant breeding and seed initiatives should continue to increase. Research agendas should also be diversified to prioritize seed- producer challenges identified in this report.
- Train more organic seed producers and support existing producers to ensure that organic seed production capacity continues to grow in the US.
- The organic seed regulation should be strengthened and consistently enforced, regardless of farm size, and buyers/processors who contract with organic producers to use specific varieties should be held accountable to the organic seed regulation.
- Organic seed stakeholders should advocate for policy initiatives that aim to decentralize power in agriculture and advance equity and justice within food and farm policies, programs, and leadership.

Introduction

Nearly twenty years have passed since the US organic regulations went into effect under the oversight of the National Organic Program (NOP). The success of the organic label has been monumental, and consumer demand for organic products shows no sign of slowing. As the highest-integrity food production standard available, this is good news.

When the NOP launched in 2002, the new regulations contained an aspirational goal: to require organic growers to use organic seed. Because few organic seed suppliers existed at the time, the regulations allowed growers to source seed that wasn't certified organic when they could demonstrate a lack of commercial availability of organic seed. This leeway still exists, but the availability of organic seed has increased tremendously over the past two decades as organic seed systems have taken root.

State of Organic Seed (SOS) is an ongoing project to monitor organic seed systems in the US. Every five years, Organic Seed Alliance (OSA) releases this progress report and action plan for increasing the organic seed supply while fostering seed grower networks and policies that aim to decentralize power and ownership in seed systems. More than ever, organic seed is viewed as the foundation of organic integrity and an essential component to furthering the principles underpinning the organic movement. We are proud to share this third update.

BEYOND A REGULATORY REQUIREMENT

The organic food market experienced incredible growth in 2020, with sales surpassing $56 billion, representing more than 12 percent growth compared to the previous year.[1] The organic seed market has also grown in recent years due to this organic food market growth, as well as a dramatic increase in gardening during the COVID-19 pandemic (see "The COVID-19 pandemic spurs historic seed sales"). As we celebrate these market successes, we may lose track of the broader benefits of expanding organic seed systems that support the flourishing organic industry.

Seeds are alive and adapt to changing climates through seed saving, selection, and other classical plant-breeding techniques. This adaptation is key for a crop's survival—mitigating risks for growers and the communities they feed. Organic plant breeding and organic seed are therefore key elements of adaptable and resilient farming systems. When these seeds are grown organically, the climate benefits are even greater. Beyond mitigating the impacts of our warming planet, organic practices also reduce greenhouse gas contributions. For example, organic seed is produced without fossil fuel-based fertilizers, a major contributor of greenhouse gas emissions.[2]

In addition to adapting crops to changing climates, organic plant breeding provides growers other benefits. The challenges inherent in organic farming are different from those in conventional systems, where synthetic pesticides and fertilizers are commonly used to control pests and diseases and to provide plant nutrition. Seed provides the genetic tools to confront these day-to-day challenges in the field, and some research shows that breeding plants in the environment of their intended use—a targeted region or production system, such as organic—allows for crops to perform better in those environments. Furthermore, many organic plant-breeding projects embrace participatory models, where farmers collaborate with formal plant breeders to share knowledge, skills, and priorities. Participatory plant breeding can result in higher-quality organic seed and can provide farmers the skills they need to develop and improve their own varieties.

Farming has a huge impact on our environment and on human health. This is most evident when looking at the number and volume of chemical pesticides applied to farm fields each year and the resulting harm to non-target organisms, water and soil quality, and human health. As one example, neonicotinoids are the most widely used insecticides in the US. Most neonics enter the environment as a seed treatment, where seeds—the majority of corn seed, for example—are coated with an insecticide prior to planting. Studies show that neonic seed treatments, which are often paired with fungicides, impair the natural defense systems of pollinators and other insects, reducing their populations and putting food crops that rely on pollinators—35 percent of the world's food crops—at risk.[3]

We have to work together to shift power from agrochemical interests to organic farmers.

– Ira Wallace
SOUTHERN EXPOSURE SEED EXCHANGE

In 2021, the state of Nebraska sued an ethanol plant for improper storage and disposal of 84,000 tons of neonic-treated seeds.[4] Seeds treated with synthetic chemicals are considered too toxic to use as animal feed or to spread on fields. Instead, the chemicals were piled up on the ethanol plant's property and they leached into the ground and water supply, and the odor caused some local residents to suffer health impacts. Organic seeds are grown without synthetic chemicals in the field and are not treated with synthetic chemical seed coatings; growers who plant organic seed are choosing to keep pollution caused by synthetic pesticides out of our soils, water, air, and food.

WHY IS ORGANIC THE HIGHEST-INTEGRITY FOOD PRODUCTION STANDARD?

Organic certification is a voluntary process designed to verify every step of the organic supply chain in accordance with federal regulations. It is the most comprehensively regulated and closely monitored food production system in the US. Organic farms and businesses must adhere to the same strict practices regardless of size. The regulations are monitored and enforced by the US Department of Agriculture's National Organic Program. While organic certification isn't a good fit for every operation or business, the organic standards provide the strongest food production label available to us today, and certification therefore serves as one of the many solutions to improving the health and resiliency of our food and agricultural systems.

We also believe that a healthy seed system is decentralized, with many decision makers at the table: seed growers/savers, plant breeders, farmers, consumers, chefs, food and seed businesses, Indigenous seed keepers and tribal nations, and others. In important ways, the expansion of organic seed systems has embraced decentralized approaches to plant breeding (e.g., participatory breeding models), seed production (e.g., regional seed grower networks), and distribution (e.g., new seed businesses continue to emerge). Increasingly, chefs, retailers, and food companies are involved in variety tastings and evaluations—identifying organic seed and food market gaps—and even in organic plant-breeding projects. This diversity of decision makers fosters a participatory and decentralized nature to organic seed systems that results in varieties with aesthetic and culinary qualities that are desired by consumers, while also addressing the agronomic challenges of organic farmers.

As a social movement, we have long believed that organic seed can take a distinct path from the dominant conventional seed industry, where consolidation and privatization are key strategies. As the seed industry further concentrates ownership of seed, we see evidence that organic seed growers and their networks are striving to expand the organic seed supply through strategies of decentralized power and ownership to avoid the negative consequences of consolidation. These consequences have included less choice in the market, higher seed prices, genetic uniformity in our fields, restrictions on seed saving and research, and very little transparency. By contrast, organic seed systems have an opportunity to be defined not by what they exclude—such as genetically modified organisms (GMOs) and synthetic chemical pesticides—but by what they embrace: **collaboration, cultural heritage, diversity, fairness, health, beauty, and hope.**

PROJECT OBJECTIVES AND PRINCIPLES

The SOS project is guided by the following objectives, each of which contributes to our primary goal of expanding grower access to organic seed:

- Improve organic seed stakeholders' understanding of the barriers and opportunities in building organic seed systems (stakeholders include organic seed growers/savers, organic farmers, plant breeders, certifiers, the seed and food industries, extension officers, researchers, and others).
- Build regional seed networks that support a national supply chain of organic seed.
- Help organic farmers meet the NOP organic seed requirement.
- Advocate for a stronger organic seed regulation to increase organic seed sourcing with the goal of eventually achieving 100 percent usage on all organic acreage.
- Support regulatory approaches that protect organic seed from contamination by excluded methods (e.g., GMOs) and prohibited substances without unintentionally damaging the organic seed industry.
- Improve how seed is managed, both privately and publicly, to reduce concentration of ownership and stimulate competition and innovation, including addressing problematic intellectual property rights (IPR) associated with seed.
- Address barriers to organic agriculture and the seed market faced by Black, Indigenous, Asian and Pacific Islander, Latin American, Multi-Racial, and LGBTQIA+ growers who currently face prejudice and endure harm.
- Identify urgent organic seed research and education needs and increase investments to fund these and other priorities to improve organic seed availability, quality, and integrity.

While the data contained in this report is based on certified organic production, OSA's vision for organic seed systems includes seed growers who are committed to organic and agroecological practices and principles, whether certified or not. We believe strongly in organic certification and the benefits to growers, consumers, and the planet. We also recognize that organic certification is not the right fit for every grower and that barriers to certification and the organic market exist.

Some of these barriers include inequitable land ownership and long-standing institutional racism. For example, only 3 percent of organic farmers are people of color, and USDA data show that organic farms with white operators earn significantly more than other racial groups.[5] Furthermore, the representation of farmers of color in organic is lower than the nationwide rate, where 4.6 percent of all farmers are people of color.[6] These realities bring racial inequities within agriculture into sharp relief.

Barriers to organic certification include the three-year transition period, which presents a significant financial hurdle because growers face higher production costs without receiving organic price premiums during the transition. Other barriers include access to capital, training, and technical assistance, and keeping up with the demands of the certification process.

We believe fostering diverse and healthy seed systems is not possible without reckoning with the legacies of harm to people of color in the US, including the history of harm in agriculture. This includes acknowledging that the organic industry contributes to inequity and injustice in our food and agricultural systems and needs to shift power to those historically marginalized in the organic food system. Systemic racism negatively affects all communities—and that includes seed communities. It is important to examine the histories and contributions of seed saving and sharing among Black, Indigenous, and other people of color (BIPOC) and the role these legacies still play in our food systems.

We view organic agriculture as more than a package of production practices, but as a necessary social movement that can create a sustainable and equitable path for our food and agricultural systems.

As such, we have updated the principles guiding this project to fill specific social justice gaps that we humbly acknowledge were absent in previous SOS reports. We view organic agriculture as more than a package of production practices, but as a necessary social movement that can create a sustainable and equitable path for our food and agricultural systems. The following principles for fostering the organic seed movement were first established in our 2011 report and have been evolving with stakeholder input ever since:

- Organic food should begin with organic seed.
- Seeds are a vital yet vulnerable natural resource that must be respected and managed in a manner that enhances their long-term viability and integrity.
- The maintenance and improvement of genetic and biological diversity are essential for the success of sustainable, healthy food systems and the greater global food supply.
- The equitable exchange of plant genetics, with appropriate acknowledgement, consent, and compensation, enhances innovation and curtails the negative impacts of concentrated ownership and consolidated power in decision making.
- Growers and their communities have the right to determine whether, and how, culturally important seeds are used and shared to avoid biopiracy.
- Sharing information enhances research and leads to better adaptation of best practices.
- Grower participation in decision-making—in the field and in policy—results in the co-creation of knowledge and shared solutions.
- Action must be taken to remove structural barriers to a just and equitable seed and food system.
- Agricultural research should serve more than one goal and should strive to increase benefits for all living systems, including soil, plants, animals, and humans.
- Public institutions and public employees should serve the country's agricultural needs, particularly the diverse and alternative systems less supported by the current economic system.
- Growers have inherent rights as agricultural stewards, including the ability to save, own, and sell seeds, and are key leaders in developing best practices, applicable research, and agricultural regulations and policy that affect them and the future of seed.
- Indigenous knowledge should be recognized as the foundation of organic farming and agroecology and uplifted in partnerships and leadership.
- The precautionary principle of protecting food systems from harm when scientific investigation has found potential risk helps safeguard food security in the future.

These principles suggest inherent benefits to developing organic seed systems. These benefits go beyond helping certified organic growers meet a regulatory requirement to source organic seed and extend to positive impacts on our climate, the environment, human health, and society.

DATA COLLECTION METHODS

This report is a tool for monitoring progress toward meeting the organic seed needs of organic growers in the United States. We hope it also helps readers understand the intersection of various stakeholders involved in organic seed systems and how to support their success (see "How to use this report"). The report's findings are drawn from seven data sets: four different surveys for organic growers, certifiers, researchers, and seed producers (which includes seed companies); seed producer interviews; a database of organic research project funding; and grower focus groups organized by Organic Farming Research Foundation (OFRF). Our methods are further described in the appendices.

DATA SETS USED IN THIS REPORT

Organic producer survey	1,059 certified organic crop producers responded to the OSA/OFRF survey in 2019 and 2020. The survey included questions on demographics, organic seed usage, and opinions on organic seed, plant breeding, IPR, and genetic engineering. A similar survey was distributed for the 2016 and 2011 reports.
Certifier survey	25 individuals representing 22 Accredited Certifying Agencies responded to our survey in 2020. The survey included questions on how the organic seed requirement is being enforced, the challenges ACAs face in enforcement, and their ideas for how to make enforcement more consistent. A similar survey was distributed for the 2016 report.
Researcher survey	51 researchers working in organic breeding or organic seed research responded to our survey in 2021. The survey included questions on their research, their networks, and their perspectives on resilience, climate change, and IPR. A similar survey was distributed for the 2016 report.
Seed producer and company survey	127 organic seed producers and organic seed companies responded to our survey in 2020. The survey included questions on demographics, challenges, research needs, their networks, and their perspectives on resilience, climate change, and IPR.
Research investments analysis	We searched and compiled USDA program and foundation funding lists of public organic seed and breeding projects. Projects were categorized according to topic, region, funding source, and crop type.
Seed producer interviews	26 of the seed producers who responded to the seed producer survey agreed to a follow-up interview. Interviewees provided additional details on the challenges and research needs reported in their responses
Grower focus groups	OFRF led 16 focus groups representing more than 100 certified organic and transitioning producers between 2020 and 2021.

Despite extensive data-collection efforts, we know that holes in our research and analysis exist. The biggest gap continues to be market data on the commercial availability of organic seed. A comprehensive, reliable database of organic seed—or a regular market assessment—would help us more fully understand the state of the organic seed supply and where gaps exist.

HOW TO USE THIS REPORT

- If you are an **organic seed grower**, or thinking about growing organic seed, we hope this report informs your understanding of organic seed systems, how other organic seed growers find support and success through various networks, and the important role that seed policy plays in our seed systems.
- If you are an **organic certifier, inspector, or regulator**, we hope this report informs your understanding of trends in organic seed sourcing and enforcement and the important role you play in encouraging the expansion of organic seed systems.
- If you are an **organic plant breeder, researcher, or student**, we hope this report helps you understand emerging breeding and research priorities, both in the natural and social sciences, and that it aids you in identifying future funding opportunities for your work—and maybe even potential collaborators.
- If you are an **organic seed company**, we hope this report helps you understand trends and perspectives related to organic seed sourcing, market needs and opportunities, and the way policy advocacy can support growth in the organic seed supply.
- If you are an **organic farmer**, we hope this report underscores the importance of sourcing organic seed for the crops you grow to ensure strong integrity of the organic label and that the benefits of organic seed go beyond meeting a regulatory requirement.
- If you are a **policy maker**, we hope this report clarifies the important role that seed systems play in the success of growers you serve—especially organic growers—and that decentralizing the highly consolidated and privatized seed industry is a social justice issue that can't be ignored.
- If you are a **seed advocate**, we hope this report provides the information and inspiration you need to take action to change seed systems—whether that's informing your next seed purchasing decision or educating your policymakers about the benefits of organic seed.

HOW THIS REPORT IS ORGANIZED

CHAPTER 1 covers the field of organic plant breeding by highlighting the common goals motivating these types of projects and the methods used. We also summarize plant breeding priorities by crop types as identified through our organic producer survey. We then share updated data on public investments in organic plant breeding and other organic seed initiatives, allowing us to report on progress seen since our last report in 2016. Through a survey of organic researchers, we are also able to identify outcomes, challenges, and ongoing needs from the perspective of grant-funded research programs, as well as these researchers' opinions on various IPR strategies.

CHAPTER 2 discusses the needs of organic seed producers, including seed companies, by reporting on both production and non-production challenges identified through a national survey of seed producers/companies. This chapter reveals the growing impacts of climate change on seed producers, seed producers' perspectives on IPR strategies, and how these producers define a resilient seed system. We also share how seed producer networks are currently structured, including who these producers collaborate with, where they source germplasm and production information from, and more.

CHAPTER 3 provides an overview of findings from our third organic producer survey. These findings help us understand how much organic seed producers are sourcing for their operations by crop type, where they source seed from, what factors impede organic seed sourcing, and the role that certifiers play in encouraging more organic seed usage. We also share takeaways from our certifier survey in this chapter to better understand certifiers' perspectives and practices as they relate to enforcing the organic seed regulation.

CHAPTER 4 includes an overview of seed policy issues, beginning with an update on progress toward strengthening the organic seed regulation and clarifying excluded methods. Other policy areas covered include seed industry concentration, IPR tools and strategies, GMO contamination, and investments in public plant breeding. Organic seed stakeholders identified these policy issues as priorities through a policy survey we conducted in 2020.

CHAPTER 1

Organic Plant Breeding

Seeds are a living link to histories and futures, connecting us to a larger community. For centuries, seed saving allowed the genetic and cultural heritage of seeds to be passed on to the next generation, to travel great distances from centers of origin, and to adapt to different environments. In this way, the seeds that sustain us are only available because of the persistence of both plants and people, and their co-evolution.

Plant breeding is rooted in this long history of seed saving. Indeed, plant breeding and seed saving have always occurred together, alongside natural selection, and are responsible for the food crops we enjoy today. Farmers, gardeners, and seed savers the world over continue to conserve and improve crops through time-honored seed saving, sharing, and storage systems.

Plant breeding is widely recognized as a craft and science for developing or enhancing plant varieties. Different forms of modern-day plant breeding exist, ranging from lab-based methods operating at the cellular level to classical techniques applied through field-based selection of whole plants. While the two forms can complement each other, for purposes of this report, we mostly refer to plant breeding in the classical sense. With plant breeding comes a responsibility to carefully steward the world's foundation of plant genetics, especially in the context of agriculture. It's our responsibility to ensure future generations have the seed they need for their sustenance as well.

WHAT IS ORGANIC PLANT BREEDING?

Organic plant breeding is the practice of breeding plants in and for organic agriculture. Though still a burgeoning field, more farmers, universities, seed companies, and nonprofit organizations are embracing organic plant-breeding methods and goals. This is evidenced by the research investments described below, in addition to emerging studies that demonstrate effective methods and models for this area of practice.[7] These studies show that organic plant-breeding projects are motivated by one or more of the following goals: (1) adapting seed to organic farming systems, (2) prioritizing traits important to organic growers and consumers, (3) increasing the organic seed supply, and (4) honoring the principles and values underpinning the organic movement, including equity and justice.[8] These goals are further explored below.

Adapting seed to organic farming systems

Adapting plant genetics to specific regions and growing practices is an effective strategy for strengthening climate resilience—both on the farm and for the broader seed and food system. Organic plant breeding embraces selection under organic conditions over the course of several generations. Studies show the benefits of breeding crops in the environment of their intended use, including evidence that conventionally bred varieties don't always perform as well under organic and low-input conditions.[9]

While there are overlaps in breeding goals for conventional and organic production, such as improving yields and disease resistance, priorities are often different because the farming practices and inputs are different. For example, conventional systems can compensate for a plant variety lacking important traits (e.g., nitrogen-use efficiency) through inputs prohibited in organic systems (e.g., synthetic nitrogen fertilizer). In this way, conventionally bred varieties can rely on synthetic inputs for their success. Ideally, varieties bred for organic systems have intrinsic traits that benefit from a whole-systems approach to pest, disease, and nutrient management. This distinction dictates organic plant-breeding priorities in addition to other needs informed by the targeted region, market, and culture.

> *We are having to use varieties and species that have been bred to perform differently.*
>
> *Some crops in the field…just seem to compete better with weeds than others, so they compete better with some of our organic practices. And so that tells me that if we had some breeding programs for selecting around organic production practices we could make a lot of headway.* — **ORGANIC PRODUCER**

Prioritizing traits important to organic growers and consumers

Organic farmers understand the benefits of organic plant breeding. Most of the producers (86 percent) who responded to our national survey (discussed in Chapter 3) believe that varieties bred for organic production are important to the overall success of organic agriculture. Organic crop researchers play an important role in meeting these needs. Our nationwide research survey (discussed later in this chapter) finds that organic crop research agendas generally align with the needs of organic growers. This is evidenced by survey results that communicate the needs and priorities for organic plant breeding (see "Organic plant breeding priorities reported by growers and researchers").

ORGANIC PLANT BREEDING PRIORITIES REPORTED BY GROWERS AND RESEARCHERS

Organic producers were asked which crops are most in need of improvement and which traits should be prioritized. They reported the following organic plant-breeding priorities by crop type. Crops and traits are listed in order of identified importance.

- **Field crops**:
  - Corn (yield, competitiveness with weeds, and nutrient-use efficiency)
  - Soy (competitiveness with weeds, germination/seedling vigor, and yield)
  - Wheat (yield, quality, and nutrient-use efficiency)
- **Vegetables**:
  - Tomatoes (disease resistance/tolerance, flavor, and quality)
  - Brassicas (disease resistance/tolerance, heat tolerance, and yield)
  - Cucurbits (disease resistance/tolerance, yield, and heat tolerance)

These results are similar to our 2011 and 2016 report findings, although interest in heat-tolerance in brassicas and cucurbits is new.

Organic plant breeders and other researchers were provided the same list of crop traits as organic producers to score the importance of these characteristics for the crop types that they work with. They identified the following characteristics as most important for their work:

- Vegetables (disease resistance, flavor, and germination/seedling vigor)
- Field crops, small grains, and pulses (disease resistance, yield, and abiotic stress resistance)
- Forage and cover crops (yield, cold-hardiness/season extension, abiotic stress resistance

Research by the Hartman Group, a market analysis firm, provides insight into the organic market, including consumer attitudes and behaviors surrounding the organic landscape. Their most recent study, "Organic and Beyond 2020," concluded that perceptions of health and safety are the top reasons consumers choose to purchase organic food. Many consumers also identified organic to be a marker of a quality product that tastes better and fulfills nutritional needs.[10] Unsurprisingly, these consumer preferences show up as organic plant-breeding priorities, where flavor and nutritional content are components of many breeding-project goals and evaluations.*

Increasing the organic seed supply

Organic plant breeding and organic seed production are interrelated but distinct activities.[11] Most organic seeds on the market were bred in and for conventional farming systems, and then the seed crops were grown organically. For seeds to be certified organic, they must be produced in accordance with the organic regulations and on land certified by an accredited certifying agency. The organic regulations don't certify plant breeding practices other than clearly defining which methods (e.g., genetic engineering) are excluded and which substances (e.g., chemical seed treatments) are prohibited.

As will be discussed in the next chapter, most organic producers still rely on conventional seed for at least part (if not all) of their operation. Our data shows very little progress in increased organic seed sourcing except for some vegetable producers. Organic plant breeding can help to fill supply gaps as organic seed production increases.

Honoring the principles and values underpinning organic agriculture

As organic plant breeding expands as an area of science and as a collaborative space, breeders have an opportunity to define organic breeding not by what it excludes—such as GMOs and synthetic pesticides—but by what it embraces. Breeding principles and methods have come into sharp relief in the context of excluded methods as defined by the NOP (see the excluded methods discussion in Chapter 4). The principles described in the introduction can serve as a touchstone for ensuring that organic plant-breeding practices and philosophies support the development of decentralized and democratic seed systems. These principles are connected to those established by IFOAM in important ways: the principles of care (abiding by the precautionary principle); ecology (preserving and applying biodiversity); fairness (promoting equity and justice); and health (honoring the interrelationship of soil, plants, animals, and humans).[12]

Many organic plant breeders work to incorporate desired traits from older varieties—such as flavor and color—into modern varieties that express other useful traits, such as high yield. In this way, these "heirlooms of tomorrow" are adapted to modern environments and climates and include characteristics important to both growers and consumers (see "Heirlooms of tomorrow"). The conservation of crop genetic diversity—and adapting this diversity to changing climates, resource availability (such as water), and food production needs—is often emphasized in many organic plant-breeding projects.

We believe the broader goals of organic plant breeding can include preserving biodiversity, supporting healthy ecosystems, growing healthy food, and protecting farmers' rights to save seed and achieve seed autonomy. Increasingly, these values encompass an understanding of a crop variety's origin and appropriately acknowledging and compensating original stewards. Just as plants have intrinsic value, so does the seed knowledge that accompanies this co-evolution.

HEIRLOOMS OF TOMORROW

Edmund Frost of Common Wealth Seeds has spent more than a decade crossing traditional and modern varieties of winter squash to achieve varieties with exceptional disease resistance, eating quality, and storage life. Most recently, Frost conducted selections from an earlier cross he made between Seminole pumpkin and Waltham butternut, an outcome he calls "South Anna," named after a river near his residence in Louisa, Virginia. Frost has crossed South Anna with other varieties from both tropical and temperate climates, including a Guatemalan Ayote squash that often exhibits green flesh and a variety bred by Johnny's Selected Seeds called JWS 6823. The varieties resulting from Frost's crosses and selections are gaining popularity among butternut squash growers. Ultimately, Frost plans to have a few different varieties available that offer growers good downy mildew resistance, more uniformity, and diverse sizes and flavor profiles.[13]

Another example includes the late Jonathan Spero, a farmer-breeder known for his commitment to developing open-pollinated sweet corn that combined older landrace varieties with more popular modern varieties. He believed that growers should be able to save and adapt their own seed, and this was particularly true in his work with sweet corn. His goal was to develop open-pollinated varieties with good yield and sweetness to serve as alternatives to the dominant hybrids in the market. Spero selected for flavor, robust growth, and multiple ears per plant, but he also aimed to preserve genetic diversity to allow for adaptability. Jonathan left this world too soon in 2020, but his legacy lives on in the form of several "heirlooms of tomorrow" varieties of sweet corn (Tuxana, Top Hat, Zanadoo, Aloha #9, Festivity, and Anasazi Sweet); lettuce (Emerald Fan); broccoli (Solstice); and sugar beet (Nesvizhskaya).

* We identified these consumer preferences as part of the research investment analysis described in this chapter.

COLLABORATION AND DECENTRALIZATION AS KEY STRATEGIES

Collaboration has emerged as the process often best suited to achieve the goals described above. These goals require that breeders engage with the unique needs of organic farmers in their region, pool resources for growing out seed, and involve different bases of knowledge and experiences to navigate the tension between diversity and uniformity. In particular, participatory plant breeding is a common model used in organic breeding projects.[14] This approach involves farmers, formal plant breeders, and other stakeholders—such as seed companies and chefs—working together to set breeding priorities and to evaluate the results from both a producer and consumer perspective. By combining the practical experience of farmers, the food industry, seed companies, and formal plant breeders, these collaborations result in more organic seed with traits that are useful to organic growers—and with more growers who possess the skills to develop or improve their own varieties.

This participatory model lends itself to a decentralized approach to improving the foundation of our food system. The emergence of organic plant breeding and participatory models are in part a response to consolidation in the seed industry, where the private sector does not fulfill all the seed needs of growers—especially organic growers. Market concentration and the increased privatization of seeds have narrowed crop genetic diversity in our fields and resulted in an overemphasis on breeding for major crops and large-scale agriculture. For example, most major crops—corn, soybeans, canola, cotton, and sugar beets—are genetically engineered to be resistant to a handful of herbicides and pests.

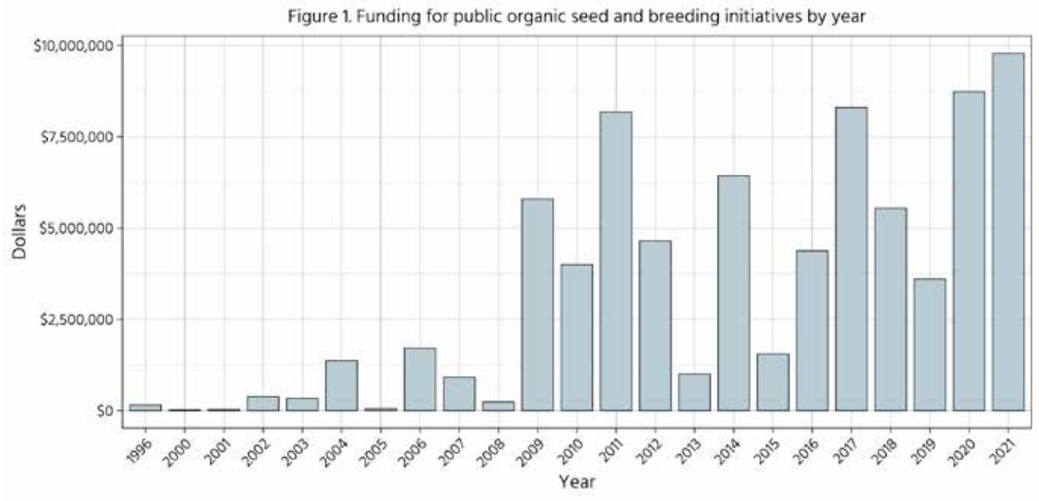
Organic agriculture is a system based on biodiversity. In the face of market consolidation, the diversity of plant breeders, breeding approaches, and stewards of our seed collections is more important than ever. Participatory models can serve as a complement to profit-driven breeding programs, and involving farmers is increasingly understood as an effective and efficient strategy for conserving crop genetic diversity and developing varieties of use to growers.

PUBLIC INVESTMENTS IN ORGANIC PLANT BREEDING AND ORGANIC SEED

While we don't have data on seed company investments in organic plant breeding, we have analyzed, for a third time, public research investments going toward organic plant breeding and other organic seed initiatives. Our findings show similar investment trends to our last report, with some notable distinctions—including a significant increase in the amount of funding.

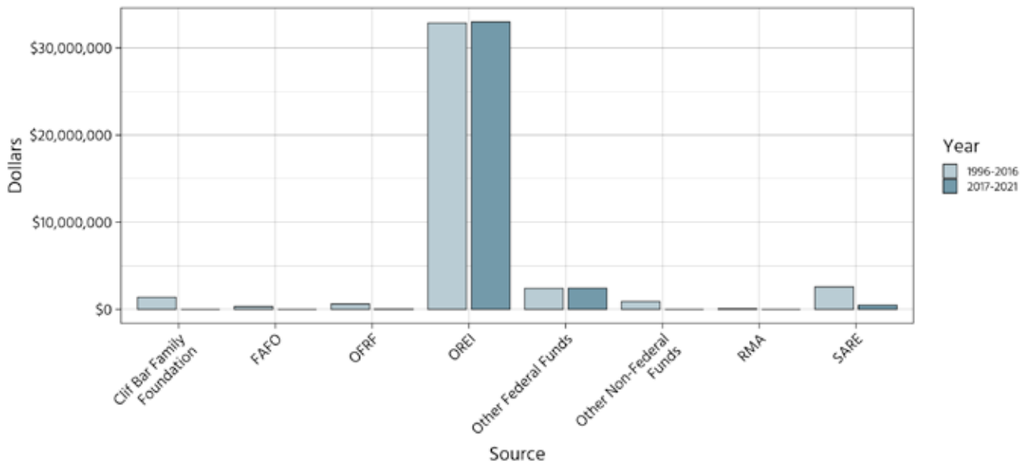
In the last five years, there has been more than $39.8 million in public investment for organic plant breeding and other organic seed initiatives. This represents the largest public investment in organic seed systems we've recorded (see Figure 1). These investments by state and federal agencies, and a handful of private foundations, are certainly something to celebrate. We view this growth as evidence that more researchers—and the granting agencies and foundations supporting them—understand that these investments are par-amount to the development of organic seed systems and the growers and communities who rely on them.

Figure 1. Funding for public organic seed and breeding initiatives by year



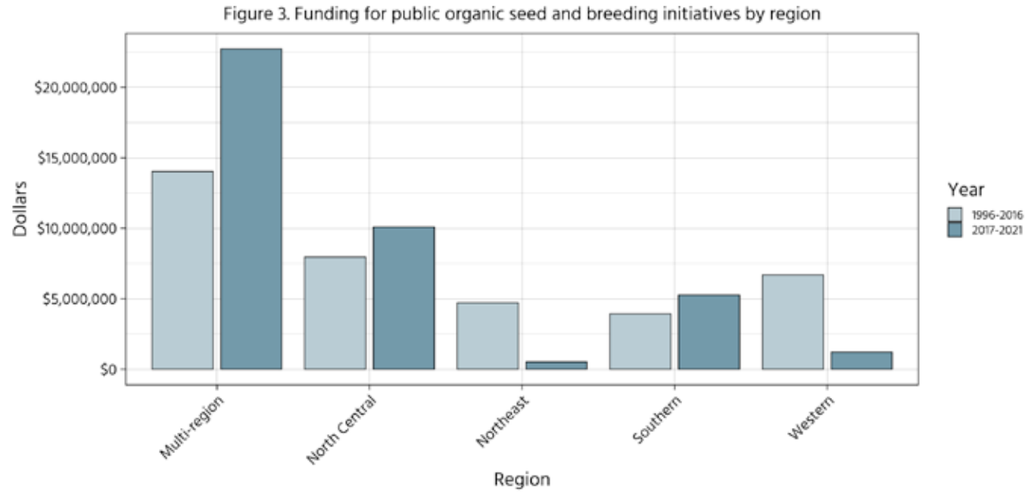
Most funding for organic plant breeding and other organic seed initiatives continues to come from the USDA's Organic Agriculture Research and Extension Initiative (OREI), representing 92 percent of investments over the last five years (see Figure 2). Collectively, since we started tracking these investments, OREI represents 85 percent of all funding that has gone toward these areas of research. Other major sources of federal funding include the Sustainable Agriculture Research and Education (SARE) program and other federal programs, including USDA's Risk Management Agency, Rural Business Development Grants, Specialty Crop Block Grants, Hatch funds, and others.

Figure 2. Funding for public organic seed and breeding initiatives by source



Many of the funding trends and priorities are the same or very similar to those reported in past reports. By region, projects labeled as "multi-regional" received the most support, followed by projects located in the North Central, Southern, Western, and Northeastern regions, respectively (see Figure 3). This finding underscores the collaborative nature of many organic plant-breeding projects, as mentioned above, where the number of multi-state and multi-stakeholder projects continues to increase.

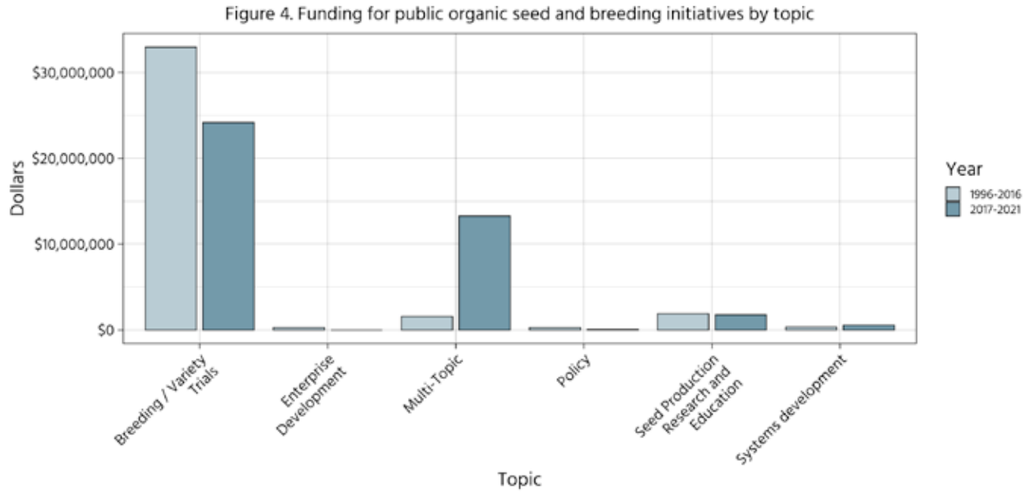
Figure 3. Funding for public organic seed and breeding initiatives by region



We also saw similarities to our 2016 report in respect to which topics received funding. Once again, plant-breeding and variety-trial projects received the most funding, followed by multi-topic projects and seed production research and education (see Figure 4). Over the last 25 years, only 5 percent of these research dollars have gone toward organic seed research and education.

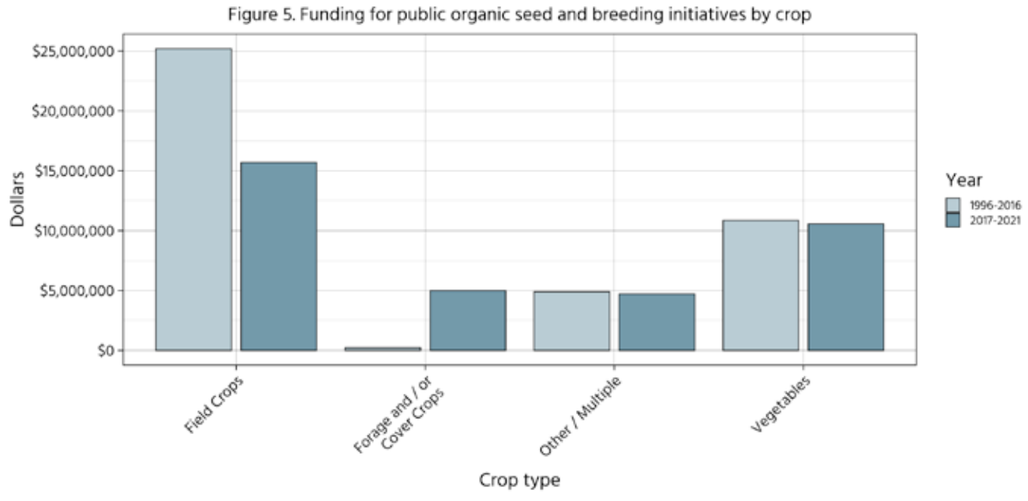
> *Most organic breeders are located in New England, Northern Europe, or the Pacific Northwest. As such, their varieties tout frost resistance but almost none are bred for the South. This is a significant and growing problem each year as the climate warms.* – ***ORGANIC PRODUCER***

Figure 4. Funding for public organic seed and breeding initiatives by topic



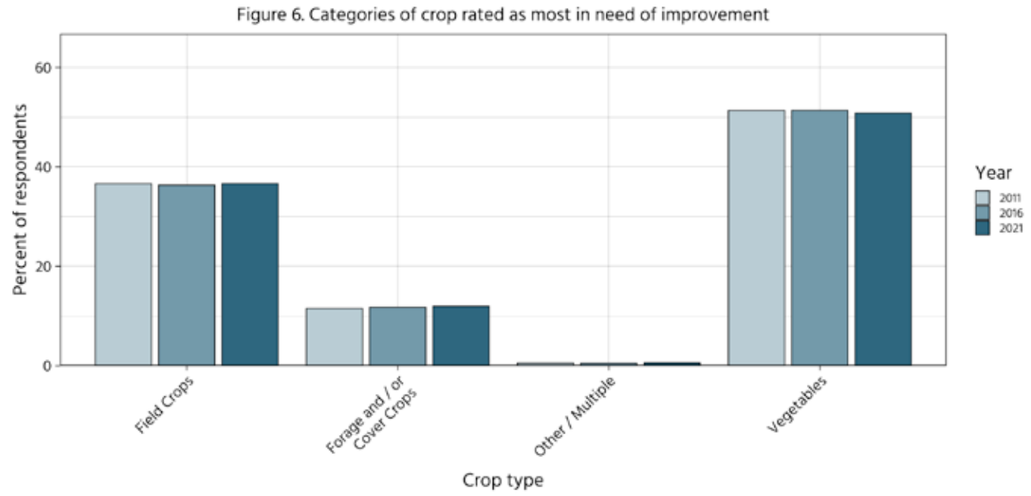
By crop type, vegetable and field-crop projects received the largest amount of support (see Figure 5). After receiving very little support in the past, forage and cover crops have seen increased investments in the last five years.

Figure 5. Funding for public organic seed and breeding initiatives by crop



In our organic producer survey (further explored in Chapter 3), we asked which crops were most in need of improvement for organic agriculture. When combining the result from this question with those from the same question in previous reports, we found that about 51 percent of respondents indicated vegetable crops, 36–37 percent field crops, 12 percent forage or cover crops, and 1 percent multiple categories (see Figure 6). Comparing the funding by crop category to the categories of crops in need of breeding, vegetable crops were the category where most producers indicated a need for breeding, while field crops received the most funding.

Figure 6. Categories of crop rated as most in need of improvement



Are current research investments equitable?

As explained above, the OREI program is currently the largest source of funding for organic plant breeding and other organic seed research investments. The 2018 Farm Bill more than doubled funding for this program, and soon OREI will award $50 million in grants annually. Given its size, the OREI program tends to award larger sums of money compared to other programs that support organic research.

This means that financial resources tend to get funneled toward larger research programs, usually at the leading land grant universities, which have staff capacity to manage government grants and the tedious paperwork and reporting that come with them. The burden of paperwork per project partner can also disincentivize paid collaboration with broader groups of stakeholders. We view this as an access and equity issue for research programs—especially smaller university programs and non-university institutions (e.g., non-profit research)—and a barrier to increasing the diversity of grant recipients and partners, especially those who lack the capacity and experience necessary to apply for and manage large grants.

To be sure, public plant-breeding programs at land grant universities are serving important needs not fulfilled by the private sector, and many are severely underfunded. At the same time, Indigenous communities and other marginalized groups have endured many injustices committed by both land grant institutions and the USDA.[15] This is a sordid history that organic plant breeders and researchers, and the funders supporting them, must reckon with if organic seed systems are to support a diversity of growers, researchers, and seed companies and to avoid perpetuating institutional racism. Given that racism is embedded in food and agriculture, and in our institutions and agencies, there is a strong need to connect plant breeding and other research priorities to social movements, with the goal of influencing seed systems and the broader food system through a justice lens.

As will be discussed in Chapter 4, organic research is already underfunded, and relying heavily on one funding source to advance organic plant breeding and seed research perpetuates a funding model that may only benefit a limited number of stakeholder groups while abandoning others. Overreliance on one program also makes organic plant breeders and other researchers—and the growers they serve—vulnerable to unpredictable delays or funding gaps caused by Congress. For example, the OREI program is reauthorized in the Farm Bill every four to five years. In 2012, due to infighting, Congress didn't pass a Farm Bill before the OREI program expired, resulting in organic research losing an entire year of funding in 2013.

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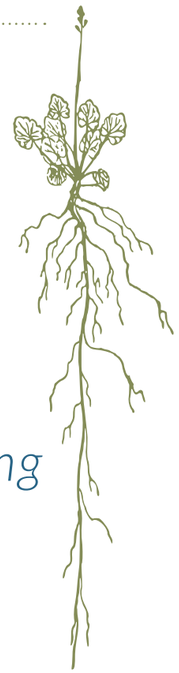


As investments increase, what results are we seeing?

In 2021, OSA conducted a survey of principal investigators listed on grant-funded projects and recent publications that focused on organic plant breeding and/or organic seed to better understand the outcomes of recent research investments. Fifty-one researchers responded to the survey, which asked questions related to their areas of research (expertise and crop priorities); project successes, challenges, and future needs; perspectives on intellectual property rights and climate change; and more. The full dataset can be explored here: https://organicseed.shinyapps.io/SOSData.

WHO TOOK OUR RESEARCHER SURVEY?

Researchers in our survey include principal investigators from both universities and organizations across the country. The response rate for this survey was 61 percent (51 out of 83).

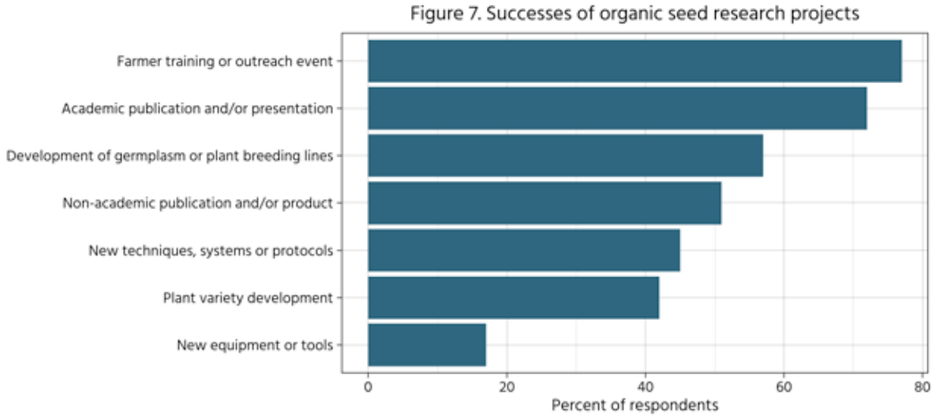
- **Where are they from?** The researchers surveyed come from 23 different states, representing universities (84 percent of responses) and organizations (16 percent).
- **What are their expertise?** The university researchers come from multiple disciplines. About half identify as breeders and a third as agronomists, geneticists, and/or horticulturalists. Less represented are soil scientists, ecologists, weed scientists, plant pathologists, and social scientists. Organization researchers specialize primarily in research and education but also in advocacy, technical support to farmers, breeding, and community development.
- **What crops do they work with?** Of the multiple crops the researchers work with, 45 percent work with vegetables, 40 percent with field crops, 32 percent with small grains, and 23 percent with forage crops.

The most common uses of public research funds, according to the researchers surveyed, included farmer trainings and outreach events (76 percent of respondents) and academic publication and/or presentations (75 percent). Researchers also reported the development or identification of germplasm or plant breeding lines as an outcome (57 percent) as well as plant variety development (41 percent) (see Figure 7).

Researchers who identified plant variety development as a project outcome were also asked if any finished varieties or breeding material were released as part of their most recent project. Of these researchers, 40 percent said they finished a variety or released breeding material. This rate is up from 2016, when 30 percent of researchers reported releasing finished varieties. To protect the material they released, most researchers (53 percent) used Material Transfer Agreements, while other IPR strategies included Plant Variety Protection (24 percent), the Open Source Seed Initiative (OSSI) pledge (12 percent), utility patents (6 percent), and licenses (6 percent).

These researchers were also asked if they were able to use earned revenue from variety releases or technology licenses to help fund their most recent project. Forty-two percent of the researchers said they were able to use earned revenue to support their project, which is up from only 15 percent in 2016.

Figure 7. Successes of organic seed research projects



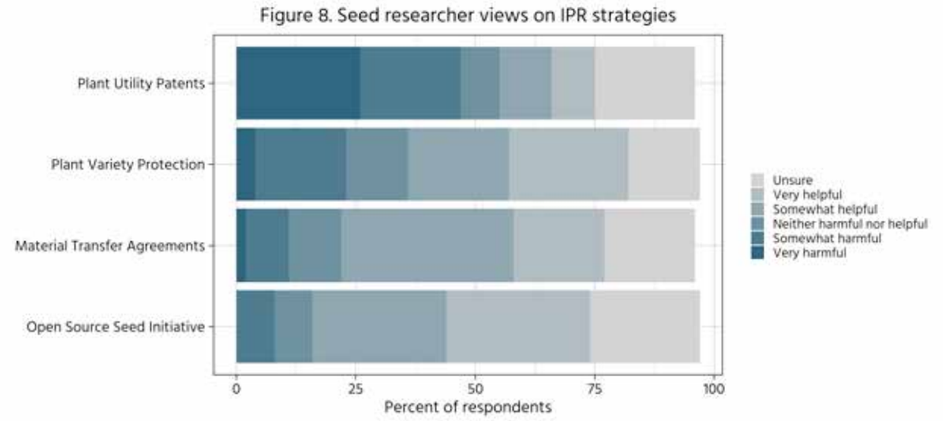
This survey also captured researchers' perspectives on IPR strategies (see Table 1). Researchers were asked how they would describe the impact of different IPR on organic seed systems, ranging from "very harmful" to "very helpful" (see Figure 8). The protections identified as "very helpful" and "somewhat helpful" were the OSSI pledge (62 percent), Material Transfer Agreements (58 percent), and Plant Variety Protection (48 percent), while only 22 percent of responses considered utility patents helpful.*

Interestingly, there is a large difference between researchers' widely perceived helpfulness of the OSSI pledge and their limited use of the pledge to protect newly released materials. This difference suggests that researchers' support for the OSSI pledge may not be shared by university technology transfer offices. The reason for that may lie in this plant breeder's remark: "My uncertainty about OSSI stems from the fact that it does not have a mechanism for the breeder to be compensated." Alternatively, some grant-funded researchers may support OSSI because they don't have to rely on royalties for the continued viability of their program.

* We recognize that bag tags—a type of shrink-wrap agreement—were not included in the survey, despite their pervasiveness. Many bag-tag licensing agreements restrict breeding, research, and seed saving, and individuals are bound to the agreement simply by opening the seed bag or packet. These agreements are often used by utility-patent owners as a way to communicate their rights and to notify users of restrictions on the seed.

TABLE 1. Intellectual property tools and strategies included in surveys

Material Transfer Agreement	Used widely in the seed trade between seed developers, farmers and developers, and others. Contracts are binding between the signatories, but the materials are often associated with one of the other forms of IP. Contracts between universities (e.g., Material Transfer Agreements) are typically used to support research, while those used by industry typically restrict research.
Plant Variety Protection (PVP)	PVP certificates are awarded to plant developers who can demonstrate their variety is new, unique, uniform, and stable. PVPs give developers exclusive marketing rights, but the Plant Variety Protection Act governing this program explicitly allows PVP varieties to be used for research and breeding purposes and allows growers to save PVP varieties for on-farm use (i.e., a grower can't sell PVP seed). PVPs last twenty years and then these varieties enter the public domain.
Utility Patent	Utility patents are available through the US Patent and Trademark Office for inventions that are novel, non-obvious, and useful. They have been awarded for finished varieties, plant parts, genetic traits, and more. Utility patents apply to all users regardless of how they obtain the material. Utility patents last twenty years and can be enforced to restrict seed saving, research, breeding, and more.
Open Source Seed Initiative Pledge	An OSSI pledge covers varieties that aren't protected by another form of IP rights. Plant breeders must submit an application to the OSSI Variety Review Committee to earn approval for using the OSSI seal and pledge, which states: "You have the freedom to use these OSSI-pledged seeds in any way you choose. In return, you pledge not to restrict others' use of the seeds…and to include this Pledge with any transfer of these seeds or their derivatives."



Researchers reported a number of obstacles in meeting the goals of their projects. The biggest obstacle reported was limited time and/or staff capacity (61 percent), followed by delays or alterations due to COVID-19 (55 percent), unexpected environmental conditions (49 percent), and insufficient funding (43 percent). As one researcher shared, "We essentially lost a whole season of seed harvesting and data collection for multiple crops due to quarantine and suspension of research operations due to COVID-19."

Challenges related to weather and environmental conditions ranged from "heat stress" and "extreme heat" to a "very rainy fall that led to high disease pressure" and "freezing temperatures inside high tunnels." The need for reliable and longer-term funding was a theme in survey responses, both within and outside federal grants. "We chase money," one researcher said, "but don't finish much."

We essentially lost a whole season of seed harvesting and data collection for multiple crops due to quarantine and suspension of research operations due to COVID-19.

TAKEAWAYS

- Organic plant breeding is an expanding field that is making progress toward a number of goals: adapting seed to organic farming systems, prioritizing traits important to organic growers, and elevating the principles that underpin the organic movement. In support of these goals, collaboration and decentralization are key strategies in organic plant-breeding projects.

- Organic plant-breeding projects pursued by researchers generally align with the needs of organic producers, where vegetables and field crops are the most popular crop categories being researched and disease resistance and yield take priority.

- Organic research investments are increasing, the bulk of which come from USDA OREI and are dedicated to breeding and variety trials. Of the USDA SARE-funded programs, multi-regional work receives the most funding, as researchers across the country collaborate to support organic research.

- As investments in organic plant breeding and organic seed increase, the organic principles are a necessary touchstone for ensuring that seed systems embrace diversity, health, and fairness as they grow alongside the success of the broader organic industry.

- Organic researchers are having greater success developing new varieties, which are most often protected by Material Transfer Agreements, and supporting their projects through earned revenue, compared to previous reports. However, challenges remain regarding staffing and capacity for researchers to carry out their projects.

CHAPTER 2

Organic Seed Production

Seed growers are at the heart of organic seed systems. From farmers who save seeds to the growers behind the varieties in seed catalogs, there wouldn't be a seed—or food—supply without these producers. By the very nature of their work, seed growers continue the time-honored practice of keeping our seeds alive and adapting to changing environmental conditions and needs. The challenges posed by climate change and seed-industry consolidation underscore the importance of centering seed growers in strategies that enhance the resiliency and sustainability of our food and farming systems.

In many communities, the local food movement has been successful in revealing the faces and stories behind the meals on our plates. We see this movement now evolving to uplift the seed growers behind our food. Uncovering the story behind our seeds allows us to reconnect with the foundation of our food system and to see more clearly the challenges and opportunities for creating organic seed systems that are diverse, resilient, responsive, and just.

To uncover the story behind the commercial seed system is to reveal a tremendous amount of industry consolidation: four companies control more than 60 percent of the global commercial market. This troubling statistic has brought more public attention to where and how seeds are grown and by whom—and to the question, "Who 'owns' seeds anyway?"

Exposing the consequences of consolidation—less genetic diversity, fewer options in the marketplace, and higher prices—has spurred a resurgence in local seed conservation and exchange efforts, as evidenced by the hundreds of seed libraries that have popped up over the last decade here in the US and across the globe. New seed companies have also emerged in response to consolidation. These are mostly small, regional enterprises focused on protecting and expanding genetic diversity, developing varieties for organic and low-input farms and gardens, and offering culinary and nutritional characteristics desired by organic consumers.

Growing seed crops requires different skills, knowledge, and equipment than growing crops for food, so targeted investments of time, resources, research, and shared learning are needed to support those interested in growing seed or expanding their seed enterprises. As we just learned in Chapter 1, though organic research funding is expanding, only 5 percent of that funding went toward organic seed production research and education. Yet, nearly 40 percent of organic farmers who responded to our national survey say they're interested in producing seed commercially.

UNDERSTANDING THE NEEDS OF ORGANIC SEED GROWERS AND COMPANIES

Over the years, State of Organic Seed has documented interest among organic crop growers in producing organic seed, and in past reports we found a growing percentage of organic farmers using their own saved seed. In 2011, 39 percent of growers who responded to our organic producer survey (not to be confused with our organic seed producer survey) said they were using seed grown on their farm, and in 2016 this number grew to 43 percent of respondents. In 2021 we found this number to be much lower, with 25 percent of respondents saying they used seed that they had saved (see Figure 9). In 2016, 63 percent of respondents to this same survey said they were producing seed for on-farm use or to sell commercially. This number dropped to 46 percent in 2021 (see Figure 10).

Fewer organic producers report saving their own seed or producing seed on their farm compared to five years ago.

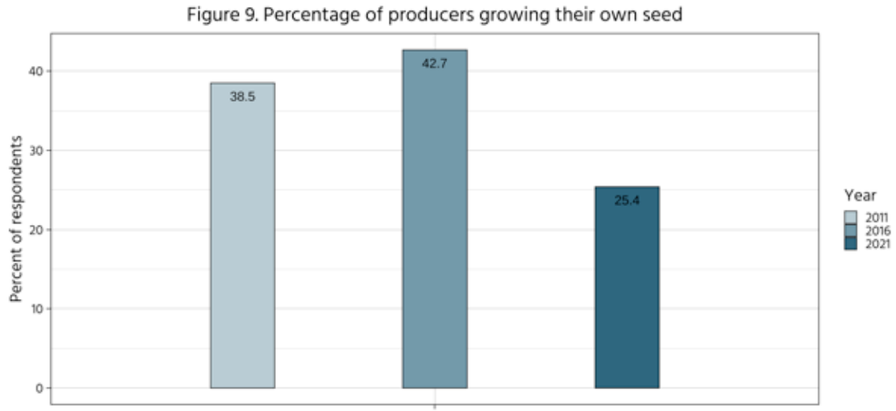


Figure 9. Percentage of producers growing their own seed

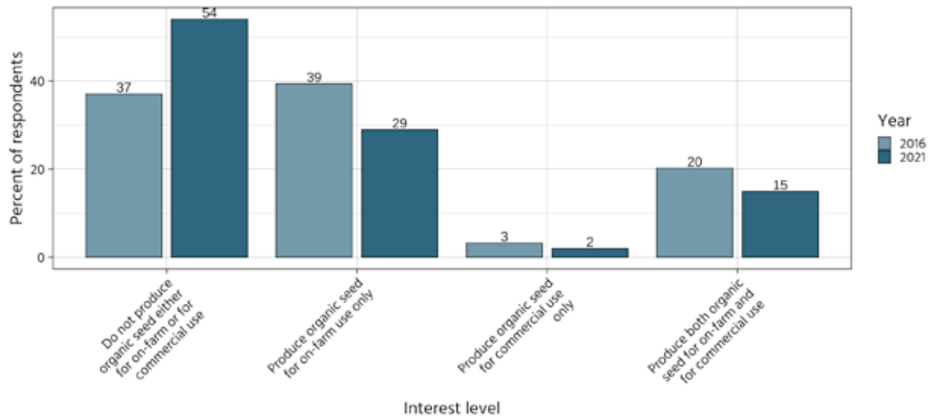


Figure 10. Extent of organic seed production by organic growers

The challenges growers face when saving or producing seed may figure prominently in the decision about whether to grow seed or not. As you'll read in this chapter, challenges loom large for growers who choose to produce seed, but a number of additional reasons factor into a grower's decision to integrate seed production into their farming operation—reasons that go beyond seed production challenges. Some of the reasons growers might choose not to grow seed crops one year (or ever) include higher input costs, labor challenges, too many crops and not enough time, the need to focus on crops with the highest profit margin, and more.

We would like to start selling organic seed but are unclear on how to do this starting on a small scale. – ***ORGANIC PRODUCER***

In 2021, we conducted a survey and interviews with certified organic seed producers to better understand their challenges. We distributed the survey to 416 seed producers from the National Organic Program's list of certified operations and to 90 organic seed companies. The full dataset, which represents 127 responses, can be explored at this link: https://organicseed.shinyapps.io/SOSData.

Our survey asked seed producers to rate the seriousness of challenges they face. We divided these challenges into two categories: (1) those related directly to production and field management ("production" challenges—see Figure 11) and (2) those that relate more broadly to social, economic, and policy issues ("non-production" challenges—see Figure 12). The greatest challenges that seed producers identified are described below.

WHO TOOK OUR SEED PRODUCER SURVEY?

Seed producers take on multiple roles in the seed supply chain. In addition to growing seed, these producers may also breed, process, and retail seed. As a result, we use the phrase "seed producer" interchangeably with seed growers and companies. The survey response rate was 25 percent (127 out of 506).

- **What roles do they take on?** Those who completed the survey represent these activities at the following rates: seed production (93 percent), seed retail (52 percent), breeding (45 percent), seed handling and/or processing (28 percent).

- **Where are they from?** The seed producers surveyed came from 31 states and three Canadian provinces. Representation in the US was similar for all USDA SARE regions except for the North Central region, which had proportionally fewer respondents.

- **What crops do they work with?** While many respondents grew more than one category of crop, most respondents work with vegetable seeds (77 percent) followed by ornamental seeds (including annual flowers and perennials—52 percent), with about a third of respondents growing seeds for field crops (31 percent), forage crops (33 percent), grain (37 percent), and propagules (35 percent).

- **Operation and experience details?** Respondents reported a wide range of incomes, with the plurality (29 percent) grossing less than $50,000. The average number of years of experience with farming was 19.5, and the average number of years of experience with seed production was 10.

SEED PRODUCTION CHALLENGES

Achieving and estimating adequate seed yields: Being able to estimate and achieve yields is critical for production planning and profitability. Achieving adequate seed yields was the top challenge reported by seed producers (78 percent of respondents—Figure 11) and estimating yields was similarly high (77 percent). To address the challenge of achieving adequate yields, producers need better ways of improving soil fertility to benefit their crops, without aiding the competing weeds and pests. Respondents explained that the challenge of estimating yield is due to an information deficit, and they provided ideas for filling this need, including "a database of expected yield ranges and market price ranges" and "regional data gathering" on crops and specific varieties.

Controlling weeds: Weed control is a common challenge for many organic producers, regardless of what they grow. For seed producers who took our survey, more than half (74 percent) identified weed control as a challenge. "When I [tracked production costs]," shared one seed producer, "weeding was one of the biggest costs." Another seed producer said, "I think the biggest thing for us in organic is weed management. Just to be able to keep nice clean fields, you can keep that disease down." Some seed producers pointed to the challenge of keeping weed seeds out of the seed they sell as well. One person commented, "It's more difficult to control weed seeds and pests in the field, often resulting in longer cleaning time and more loss of good seed from a lot."

Managing climate effects and adapting to climate change: Many seed producers commented on the difficulty of managing the effects of climate, with 77 percent reporting this as a challenge, and 71 percent specifically identifying this as a climate change adaptation challenge. Respondents pointed to fires and smoke affecting pollination and seed production, destructive winds and unpredictable freezes, and the lack of adequate rainfall. "It's getting more difficult to control plant stresses [i.e., bolting]," shared one seed producer, while another pointed to there not being "enough people doing drought- and heat-tolerant work." (See "Climate change threatens seed growers.")

Sourcing appropriate seed cleaning and harvest equipment: Having appropriate equipment is a challenge for less than a third of all the seed producers, but the need is higher for those who work only on breeding and production activities, rather than processing and retailing. Of this subset of seed producers, 65 percent identify seed cleaning equipment as a challenge and 53 percent identify seed harvest equipment as a challenge. Comments from these respondents explain the challenge of "sourcing small- to medium-scale equipment in a region that doesn't have a lot of vegetable seed production." Producers suggest solutions, such as developing "appropriate small-farm technology," identifying resources/programs for equipment cost sharing, and "sharing of techniques/tools."

> *There's also a scale issue. You really can't find great equipment for a small-scale operation easily.* – ***ORGANIC SEED PRODUCER***

CLIMATE CHANGE THREATENS SEED GROWERS

Our seed-producer survey found that climate change is a major concern for seed producers, with 88 percent of respondents believing that climate change will significantly or somewhat harm agriculture during their lifetime. This sentiment was echoed in our researcher survey covered in Chapter 1, where 65 percent of respondents said they "often" consider climate change in their organic plant breeding and seed research, and 87 percent said that climate change will "somewhat" or "significantly" harm agriculture during their lifetime. "We are already seeing an increase in temperatures from climate change as well as more numerous wildfires, with their detrimental impact on air quality," shared one researcher.

In September 2020, ten major wildfires emblazed western Oregon, consuming over one million acres in populous regions and nearly taking out irreplaceable seed supplies. As journalist Lynn Curry reported in The Counter, "For Northwest plant breeders and seed savers, warming temperatures due to climate change are a 'selection opportunity.' But it's nearly impossible to select varieties with genetics adaptable to fire."[16]

The thick smoke from the wildfires diminished sunlight and cut temperatures 10–20 degrees. In turn, the temperature and conditions delayed the ripening of seed, affecting yields. Labor was also impacted, as the air was too unhealthy to breathe.

Oregon seed growers aren't the only ones impacted by wildfires. Across the West, wildfires are becoming more frequent and intense. California seed growers know this all too well, along with other extreme climate-related challenges.

"While the fires are happening, they're incredibly urgent and in your face," said California-based seed grower Sorren of Open Circle Seeds. "For multiple years we had fires here, and dense smoke clouds—to the point where we didn't see the sun once for a whole month—and we could see the impacts: some things didn't ripen because of less sunlight, and we had fewer seeds."

"But the fires are the least of it," said Sorren. "They happen and then they're gone. This year we didn't have fires, but we had very extreme weather, and it's all climate related."

(continued on next page)

CLIMATE CHANGE THREATENS SEED GROWERS (CONTINUED)

She added, "We didn't have much rain. Usually we have rain in December through March and then it gets hot fast. This year we had a mild spring but no rain. Our last frost date is typically around May 15th, and this year we got a frost May 27th and then again the second week of June. A lot of crops were lost in that cold, and this meant we had a shorter growing season, too. After that frost in June, it went to triple digits for two months. Now, triple digits happen every year here, but this many days in a row is unusual. The ground was too hot for seeds to germinate. The sweet corn was beautiful and full size, but the plants had a lot of empty ears because pollen isn't viable when temperatures are too high. Most of our tomato plants also didn't survive."

"Nothing is ever going to be the same again," Sorren concluded. "Aside from growing seeds, I feel like my main job now is to watch for which varieties can survive the extreme climate chaos that we are facing. I also have to consider if I will still want to do seed contracts, or do I just want to grow for our own seed company so I'm not letting seed companies down? We couldn't fulfill several contracts this year."

Fortunately, Sorren said, they didn't have problems accessing irrigation due to drought conditions, unlike a lot of farmers in California and their neighbors to the north in Oregon.

In April of 2020, as the growing season was getting started, Chickadee Farm owners Sebastian Aguilar and Kelly Gelino were told that instead of having access to their normal twenty-five weeks of irrigation water, only eight would be provided, due to the severe drought conditions in southern Oregon.

"This unprecedented reduction in available water took us, and everyone we knew, by surprise," said Aguilar. "Despite 70 percent average snowpack, the parched mountains absorbed all the water and streamflow was minimal. Since we needed at least twenty weeks of water to grow the dozens of vegetable, flower, and herb seed crops in our farm plan, we were left with no choice but to call off the season."

Aguilar pointed out other fallouts as well. The first is that the seed companies who rely on them did not receive their seed orders from Chickadee Farm this year, which impacted not only the seed company but also the farmers and gardeners who rely on the varieties they grow. Second, Aguilar and Gelino had to let their farm crew go, altering the livelihoods of people beyond their own family. And, finally, without their seed crops, they didn't have the income to make ends meet.

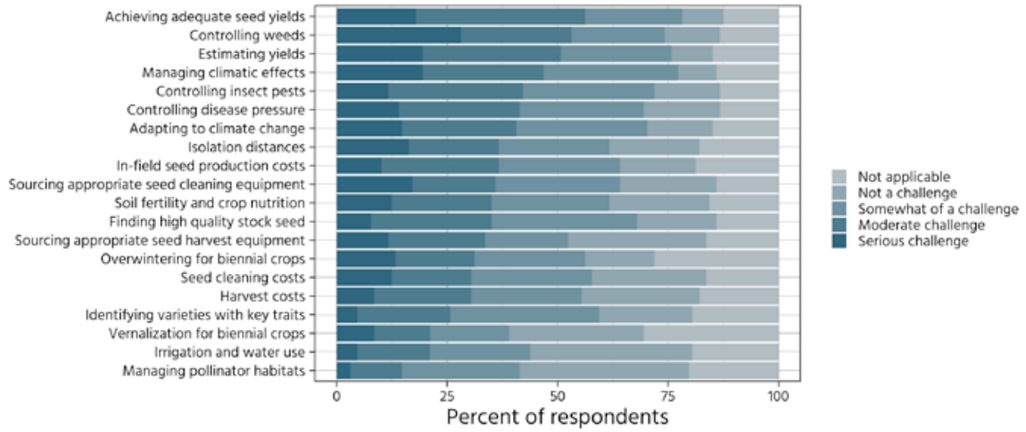
As part of their strategy for moving forward, they signed a twelve-year lease on a new farm in a different part of Oregon where there is still adequate irrigation water. They feel fortunate that through good credit, along with community and family help, they are able to rebuild their farm at the new location and are looking forward to getting back on track. This event has been traumatic, though.

"I'm always worried about what climate change is bringing us," Aguilar added. "Wind, ice storms, wildfires, drought—they are all projected to become more intense and more regular. Farming is only getting riskier and riskier, and we're hoping we'll be able to implement enough strategies to mitigate it."

"I live in a region with drastic water restriction in the main growing season, and climate change is a very real issue for us. ***– ORGANIC SEED PRODUCER***

We abandoned all our winter and spring production (about two acres of planting), because I couldn't justify starting to irrigate as early as February. Once it was clear that we weren't going to have any rain, I fallowed a lot of our ground and recalibrated to prioritize our seed crops. Each week felt like triage, assessing what crops would be let go of if we needed to tighten things to budget enough water to get through to October/November when we harvest a lot of our seed crops. **– *Kristyn Leach*, NAMU FARM**

Figure 11. Organic seed producer production challenges



CHALLENGES BEYOND PRODUCTION

Managing business activities: Managing business activities stood out as the greatest non-production challenge for seed producers (72 percent of respondents—see Figure 12). As one producer said, "It often feels like we are building the plane while we are flying it." Several producers pointed to the need for economic guides and enterprise budgets for company operations to help determine growth curves. In the words of one of these producers, "We need farm business planning and resources specific to seed production and how to integrate it to an already operating farm or start-up farm."

Developing infrastructure: Ranking as high as business management were challenges in developing infrastructure (72 percent). Respondents named several infrastructure needs—from equipment storage, to seed storage, to understanding grant and loan opportunities for supporting growth. One company shared, "How [do we] move from a very small 'cottage industry' seed company to one with [standard operating procedures], easy-to-use records, climate-controlled seed storage, and efficient fulfillment?" Another seed producer shared: "I need a shed or I need this building or something. I need a place to store my Winnow Wizard in there, but I don't have any buildings on my land . . . and it's really expensive and it takes a lot of time, and so I just don't do [it] . . ."

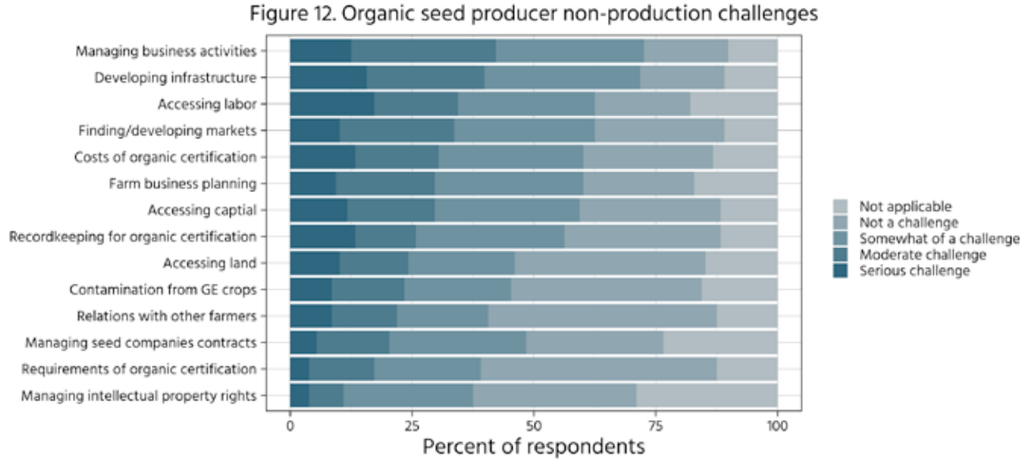
Accessing labor: Hiring labor was also a top concern (62 percent), with a large number of producers commenting on the struggles they face. We heard that labor is "short and expensive," and that "good" and "quality" help was hard to find. In general, we found that seed producers need knowledgeable and committed staff for their seed operations.

Finding/developing markets: Finding markets for organic seed was reported as a challenge for 62 percent of respondents. "I need to figure out how to increase my customer base," shared one producer, while another lamented, "Most of the seed we sell for certified organic producers is conventionally grown, untreated seed because those customers—our largest customers—do not want organic seed."

Certifying organic: Seed producers also identified organic certification as a challenge, with 60 percent of respondents noting the cost, and 55 percent noting the recordkeeping. Regarding cost, one seed producer shared: "Cost-share programs are decreasing. Certification costs are increasing, and yet many farmers still can't even afford healthcare." Comments on recordkeeping challenges fell into two categories: 1) managing highly diverse operations, and 2) the requirements of needing numerous certifications for different components of their operation. As one seed producer shared, "Due to the diversity that we grow (upwards of 200 varieties per year), the various recordkeeping requirements for certified organic production are excessive. The system penalizes biodiverse farm models." Another seed producer shared, "It would be so great if the organic certifiers actually had a channel for seed production. We are certified as a grower, processor, and handler so the paperwork is EXCESSIVE!" When producing organic seed for commercial sale, organic seed producers need both a seed certification from the state in addition to organic certification.

> *Cost-share programs are decreasing. Certification costs are increasing, and yet many farmers still can't even afford healthcare.* – ORGANIC SEED PRODUCER

Figure 12. Organic seed producer non-production challenges



Missing perspectives: challenges facing non-seed growers

Our survey of seed producers reveals the perspectives of those who have persisted in spite of challenges, but it does not represent others who may be facing (or have faced) insurmountable barriers. Conversations throughout our data collection gave us the opportunity to speak with organic growers who have been hesitant to start producing seed, or seed producers who have stopped growing seed.

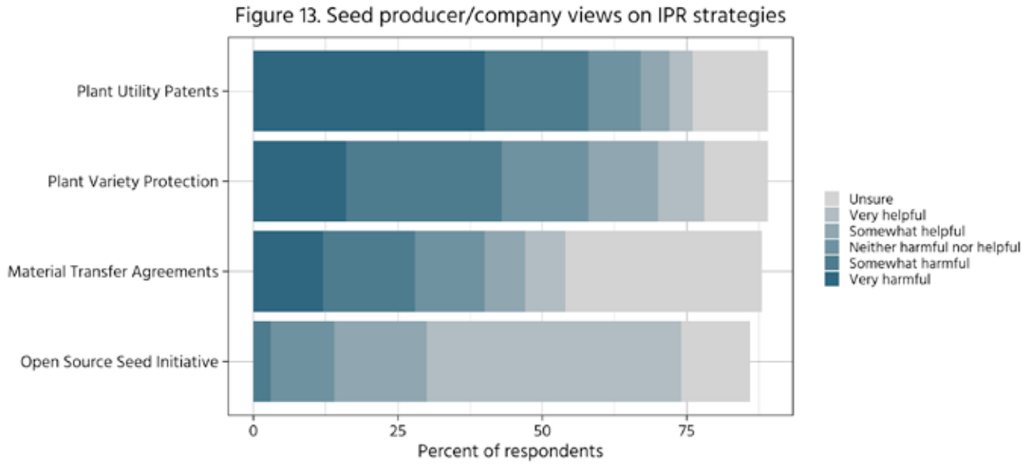
One such grower in Colorado reported giving up on growing seeds because the weed pressure was too high, and a barley grower from Oregon has stayed away from growing seed because of uncertainties about the market. More outreach is needed to hear from the potential seed producers who have faced barriers to entry into this kind of work.

Seed producer/company views on IPR strategies

Organic seed producers/companies were also asked how they would describe the impact of different intellectual property rights (IPR) on organic seed systems, using a range from "very harmful" to "very helpful" (see Figure 13). Of these respondents, nearly half (45 percent) identified utility patents as "very harmful" and an additional 20 percent said patents were "somewhat harmful." Nearly half (49 percent) of respondents felt Plant Variety Protections (PVP) were "very harmful" or "somewhat harmful"—a response that is the opposite of what we received from researchers on the same question, where 48 percent of researchers responding viewed PVPs as "somewhat helpful" or "very helpful." Perspectives on material transfer agreements were fairly neutral among organic seed producers/companies, with more than half of respondents (53 percent) saying

they were either "unsure" about their impact or thought they were "neither harmful nor helpful." The Open Source Seed Initiative pledge received the most positive endorsement by organic seed producers/companies, with 69 percent of respondents labeling the pledge as "very helpful" or "somewhat helpful." Similar to the researchers' responses on these same IPR strategies, utility patents were viewed as most harmful and the OSSI pledge as most helpful.

Figure 13. Seed producer/company views on IPR strategies



MAPPING SEED PRODUCER NETWORKS

Building regional seed networks that support a resilient national system is key to supporting organic seed. Seed networks involve a variety of stakeholders who connect in different ways—from sharing seed to sharing knowledge—and at different scales—from the local to the national level. Identifying how these networks can best work to support the seed system, and what they currently look like, can help us reflect on the state of the organic seed network as a whole.

What makes a resilient seed network?

To understand how organic seed producers envision their networks, our survey asked them to define a "resilient seed system" in their own words. The definitions provided by seed producers had multiple themes, including the role of the community, the multiple scales at which the system works, and the system's ideal tendencies in the face of stress.

First, the theme of "community" emphasized having stakeholders who are informed and knowledgeable about seed production; including a diversity of people—professionally, geographically, and demographically; and that these communities must be cooperative and work together. Second, a resilient system was often described as operating at the regional level, and as such required a decentralized network populated by multiple stakeholders at multiple scales. Third, in the face of stressors, the seed system should be flexible and adaptable to challenges, efficient and able to maintain functionality (i.e., keep producing seed), and redundant, and it must allow for evolution over time.

As one producer defined it, "A resilient seed system is one that can succeed in the face of challenges of climate, political, and market force impacts. It utilizes the decentralized network of growers, provides widespread education and communication among all participants, and fosters cooperation and sharing for the benefit of all." Together, seed producers identify that a resilient seed system should strike the balance of having diverse, decentralized regional seed networks while maintaining enough connectedness to support efficient flows of information and resources across the country.

> *[A] resilient seed system has diversity, both in plant genetics and human. It requires that seed be stewarded by a bunch of people in different places so that the genetics can be retained and improved upon over time. Networks of communication and collaboration are important to keep the diversity alive.* – ***ORGANIC SEED PRODUCER***

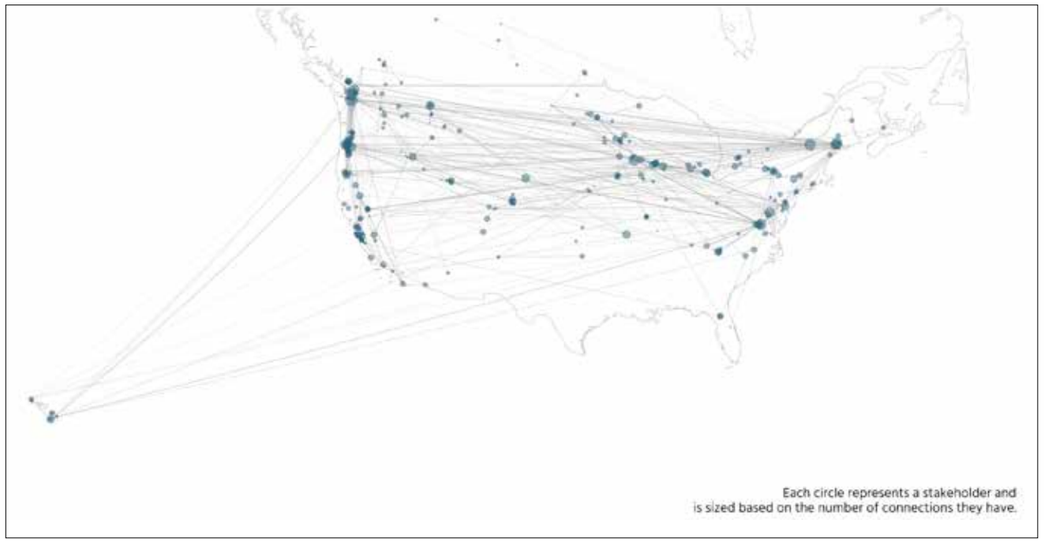
How is the seed producer network structured?

How the seed system is organized can provide insight into its resilience. A system's structure can show how power is distributed, how seed communities work together, and where there might be gaps to target support. By looking at the connections and composition of the organic seed network, we can better understand how the system is currently structured and how this relates to stakeholders' definitions of a resilient seed system.

Seed producers who took our survey were asked about their networks to help us understand how the organic seed community is organized. The survey asked questions about where seed producers source germplasm for breeding and exchanging seed, where they seek information on seed production, who they collaborate with on research, and who they work with along the supply chain, including seed contracts, equipment rental, sales, and more. The survey respondents named a whole range of stakeholders—including other seed producers, processors and retailers, organizations, university researchers, and government agencies—for a total of 349 stakeholders in the network. While these responses represent only a sample of the seed network, these connections help us understand key steps in the lifecycle of seed: how genetic material is transferred, how information is diffused to support the stakeholders in the system, and how the supply chain is coordinated.

At the national level, the seed producer network is diverse and moderately decentralized. The 349 stakeholders make over 800 connections, signaling the interdependence of those in the seed system (see Figure 14). On average, any one stakeholder has less than four degrees of separation from anyone else in the network. In each region, however, the structure and composition vary. The Western region is the largest network (243 stakeholders) and is relatively decentralized across the states. Multiple sources of seed, information, and supply chain connections are made across the West, representing redundancy in the system. On the other end of the spectrum, the Southern network is the smallest (61 stakeholders) and most centralized, with only two organizations taking a central role for a wide range of connections. In the middle, the Northeast and North Central regions are medium sized (with 93 and 121 stakeholders, respectively), each with a handful of stakeholders at the center of their networks.

Figure 14. Organic seed network



Seed producers from the smaller regions—the South, Northeast, and North Central—often reach out to stakeholders outside their region (about 65 percent of the time), especially to the West. This frequency of reaching out is much higher compared to stakeholders in the West, who largely seek out support from others inside their region. This is likely because resources are limited within the smaller-networked regions, prompting producers to look to the West for different resources like seed, information, and supply-chain connections.

[We need] production assistance with growing seeds in the Midwest. Most seed growing resources are for the Pacific Northwest. – **ORGANIC PRODUCER**

In both the Southern and Western regions, seed producers connect with a more diverse set of stakeholders. Instead of producers only working with producers, they are more likely to work with organizations, universities, and governments. Diverse connections of stakeholders in both of these regions account for 61 percent of their networks, while diverse connections account for only 43 percent of connections in the Northeast and 55 percent in the North Central.

Understanding the relationship between network size, structure, and diversity is important for guiding network formation for resilience. In the words of one seed producer, "A resilient seed system includes the participation and perspectives of many people. Large farms, small farms, gardeners, researchers, and breeders. People of color, women, those that have long been excluded."

The organic seed system connects a wide diversity of stakeholders across and within regions. Those in the organic seed network connect horizontally—with their peers and within their region—and vertically—from stakeholders with different expertise from across the country. This network structure largely reflects the definitions of a resilient seed system set out by stakeholders. Stakeholders rely at least partially on regional networks and a diversity of people for support, and though there is a much stronger regional network in the West, resources are distributed across multiple hubs. This kind of organization stands in contrast to the conventional seed system, which is increasingly concentrating power and vertically integrating their supply chains in a way that tends to disempower farmers and seed producers (see Chapter 4).

How is germplasm sourced?

Diverse seed and breeding material is the foundation of a resilient seed system. The current seed-exchange network shows that breeders and producers don't all get seeds from one central place; rather, they strike a balance between regional and national exchange. This is true to their definitions of a resilient seed system, which requires that seed be "stewarded by a bunch of people in different places so that the genetics can be retained and improved upon over time." Seed producers tend to connect with others in their geographic community to exchange and acquire genetic material: "I only source seed from backyard growers, small-scale farmers, and regional seed companies." While most seed resources tend to be regional and don't overlap between regions, the USDA's National Genetic Resources Program is one of the most popular resources for seed growers across all of the regions, indicating the important role of this centralized, publicly funded source of germplasm.

USDA'S NATIONAL GENETIC RESOURCES PROGRAM

Germplasm repositories—also known as seedbanks—are a critical element of robust seed and agricultural systems. In addition to providing a source of genetic material during periods of instability or crisis, seedbanks support vital breeding and research efforts and can help return varieties to their native habitats and stewards. There are different versions of seedbanks—from collections operated by non-profit organizations, such as Native Seeds/SEARCH and Seed Savers Exchange, to the Svalbard Global Seed Vault, which is managed under an agreement between the Norwegian government, Crop Trust, and the Nordic Genetic Resource Center. These seed collections are managed differently, yet they all store seeds for the purposes of preservation and research, and to support growers and their cultures and communities.

As part of the 1990 Farm Bill, Congress established the National Plant Germplasm System (NPGS) within the USDA for the purpose of "maintaining and enhancing a program providing for the collection, preservation, and dissemination of genetic material of importance to American food and agriculture production." There are sixteen NPGS seedbanks around the country. The Genetic Resources Information Network database catalogs plants from all of the physical banks in one cohesive online database with over 600,000 accessions.

NPGS funding has not significantly increased in more than a decade, and some managers say that collections lack the skilled personnel to actively manage NPGS locations. For example, NPGS does not have a comprehensive method for training replacement personnel, is critically short on Plant Genetic Resource managers, and expects at least one third of current PGRs to retire within five years.[17] A shrinking budget, combined with overall increases in costs, has left NPGS with less available funding, which could result in losing varieties currently in collections.[18]

How is information and research shared?

Of the different types of connections we consider in our analysis of the organic seed network, the seed system's information connections are the most centralized at the national scale. The bulk of information connections—that is, the people or groups that stakeholders go to for information and collaborations on projects—are to specialized groups (70 percent), such as non-profit organizations, universities, farming cooperatives, and government agencies. For instance, Organic Seed Alliance serves as a particularly central hub of information.* Because knowledge often requires expertise and new perspectives, one producer shared, "I think it's important we step out of everyday sources" for information. The remaining 30 percent of information connections are to other producers, and survey responses suggest these are an invaluable source of knowledge: "You just can't beat bouncing ideas/problems off other growers who are in a similar situation." In this way, seed producers and retailers support one another through mutual learning.

The openness and supportiveness of the organic seed community is a major motivation for me in my organic seed production. It is very different from the conventional sector, which I find—at least in my region—to be quite private and competitive. I have gained so much from being in the organic seed community and will always do what I can to support and sustain it. — **ORGANIC SEED PRODUCER**

How are supply chain relationships organized?

Supply chain connections are the least common kind of connection that seed producers make in their networks and involve the lowest diversity of stakeholders and lowest crossover between regions. This reflects a decentralized, regionally based supply chain network. Supply chains are fundamental to a resilient seed system, one in which "the public and farmers have the ability, infrastructure, and systems in place to supply the needs of gardeners and farmers in a given area." While these strong regional ties keep business operations within a shared geography, this also indicates that smaller regional networks, like the South and North Central, might be limited. For instance, when prompted to share about their supply chain collaborations, a producer from the North Central region commented, "I am pretty isolated out here!" This matches what we heard from seed producers regarding their challenges sourcing seed cleaning and harvesting equipment. In the South, the costs and equipment for seed cleaning and harvest rise to the top of the challenges list; this may be a consequence of the limited supply chain network in this region.

* Given that OSA sponsored the surveys, the responses are likely to have some bias toward those who are already familiar with OSA and/or were prompted to reference OSA by seeing their name on the survey.

TAKEAWAYS

- Seed producers' primary challenge is the production of seed: estimating and achieving yields; controlling weed, pest, and disease pressure; and managing climatic effects. Outside of production, managing business activities and finding markets, developing infrastructure, and finding and retaining skilled labor all rank high on the list of challenges. These challenges require more public research and capital investments.

- Climate change is already severely impacting organic seed growers, and policy actions and research investments are needed to mitigate the impacts and increase the climate robustness of our crops and seed systems.

- Most seed producers/companies who responded to our survey questions on IPR view utility patents as most harmful and the OSSI seed pledge as most helpful.

- When envisioning a resilient seed system, seed producers would like to see decentralized regional communities of seed growers that can work together to share knowledge, access markets, and maintain diverse, productive, and adapted seed.

- The current structure of the seed network mostly reflects this vision of a resilient seed system, but regions other than the West are still small, and resources along the supply chain could stand to be diversified.

- All seed networks rely on the National Plant Germplasm System, underscoring the importance of ensuring adequate funding, access, and accountability within public germplasm collections.

- Growing organic seed systems that are decentralized and democratic, and that aim to breed, produce, and distribute seed differently from the dominant corporate models, requires increasing organic seed literacy, skills, and capacity to diversify and increase the organic seed supply.

CHAPTER 3

Organic Seed Sourcing

Since organic seed is a regulatory requirement, the need for more organic seed rises with the demand for organic food. In 2020, organic food sales surpassed $56 billion, representing the highest growth rate (12.8 percent) recorded for organic sales in over a decade. The COVID-19 pandemic is responsible for at least part of this increase, given that grocery sales and the public's interest in their health and wellbeing grew exponentially.[19] The Gen Z and Millennial generations are also a substantial contributor to this growth.[20] Public interest in gardening also skyrocketed, as evidenced by a surge in organic seed sales (see "The COVID-19 pandemic spurs historic seed sales").

Organic seed represents the first link in the organic supply chain, serving as the foundation for organic integrity from seed to plate. OSA's research provides evidence that organic seed sourcing is increasing among smaller vegetable producers but that progress toward 100 percent organic seed usage in all crop types remains stagnant. A survey of certified organic producers underscores the importance of monitoring organic seed needs by crop type and region. These findings also reinforce the need to advance organic seed systems that underpin a robust organic seed supply.

FIFTEEN YEARS OF ORGANIC SEED SOURCING

How much organic seed is being planted?

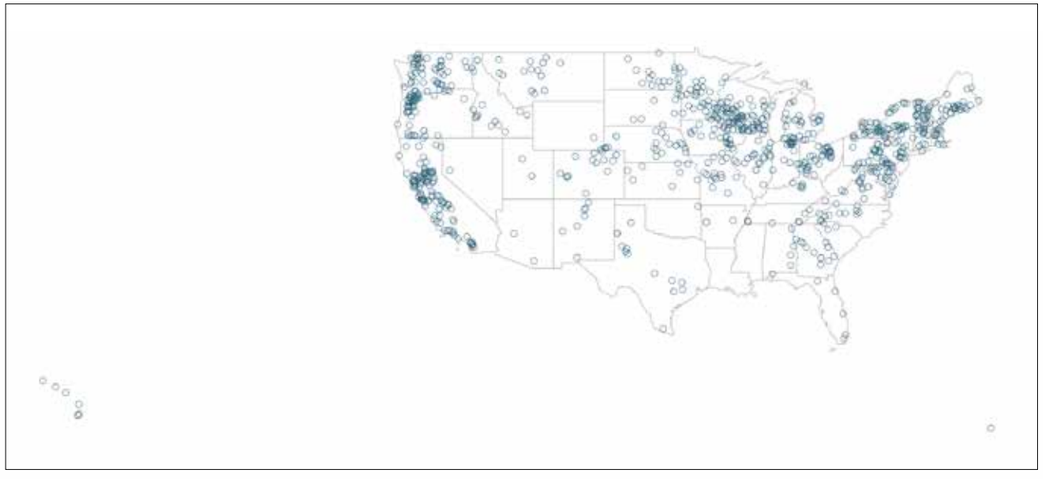
In 2019, we distributed the State of Organic Seed project's third organic producer survey as part of the Organic Farming Research Foundation's National Organic Research Agenda survey. Together, with the support of Washington State University's Social and Economic Sciences Research Center, we contacted as many certified organic producers in the US as possible and received 1,059 responses. See the appendices to read our methods and view the full dataset. The dataset can also be explored at this link: https://organicseed.shinyapps.io/SOSData.

WHO TOOK OUR PRODUCER SURVEY?

Organic producers—not to be confused with organic seed producers.

- **Where are they from?** Organic growers are located across the US, with a large number of responses from the North Central and Northeast (see Figure 15).
- **What crops do they work with?** Growers can produce multiple categories of crops. Most grow cover crops (64 percent), followed by field crops (48 percent), vegetables (40 percent), and forage crops (15 percent). About 20 percent more producers grew cover crops compared to 2016, while there were about 55 percent fewer forage producers responding to the survey this time around.
- **Organic certification details?** Most organic producers who responded to our survey have been certified for fewer than ten years, though we had more long-time (twenty-plus years) certified operations responding this time compared to our last survey.

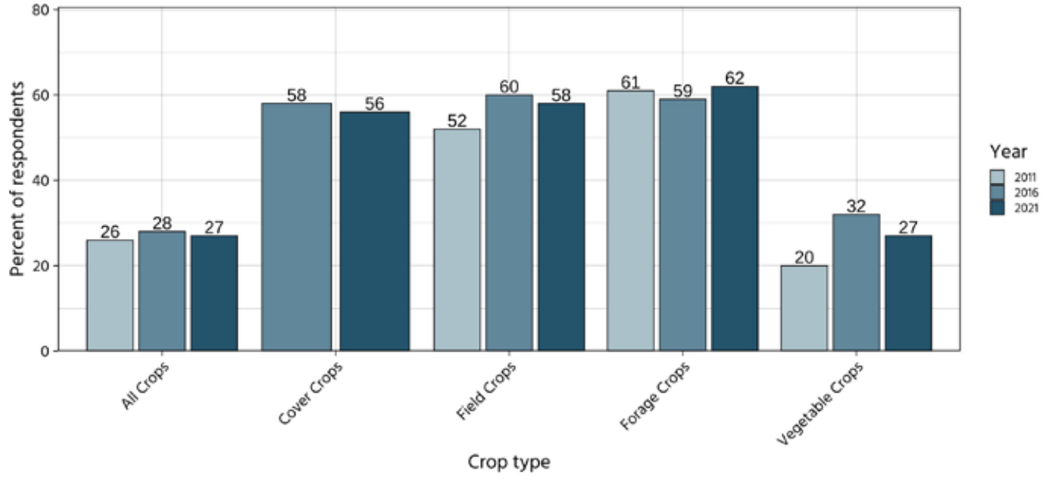
Figure 15. Map of organic producer survey responses



There was no meaningful growth in the numbers of organic producers using all organic seed (i.e., 100 percent of the seed they source is organic) compared to our last survey. Of those responding, 27 percent reported using all organic seed compared to 28 percent in 2016 and 26 percent in 2011 (see Figure 16). Organic seed usage in vegetable, field, cover, and forage crops remains stagnant compared to 2016 data. The one exception is that we saw an increase in organic seed usage among smaller scale vegetable producers (less than 50 acres).

Organic seed usage in vegetable, field, cover, and forage crops remains stagnant compared to 2016 data. The one exception is that we saw an increase in organic seed usage among smaller scale vegetable producers (less than 50 acres).

Figure 16. Percent of respondents using all organic seed for each crop type



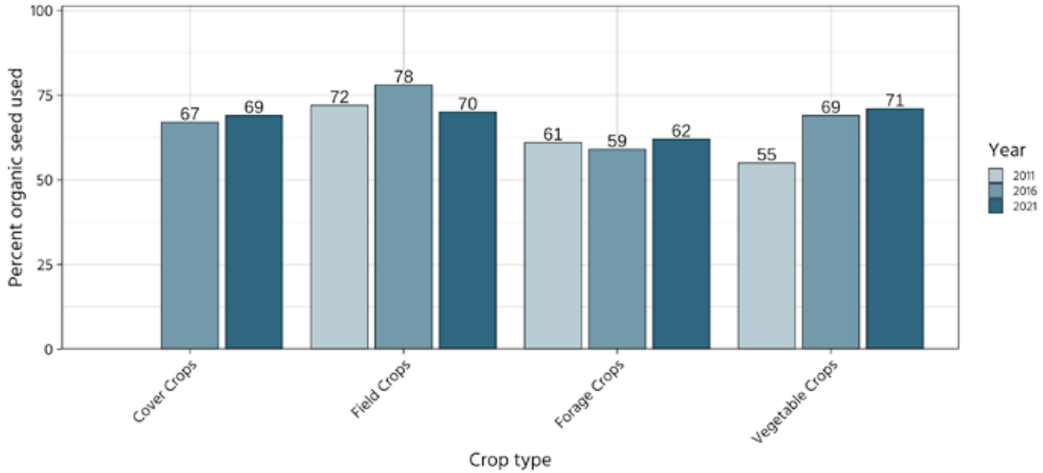
Vegetables: On average, respondents reported planting organic seed on about 70 percent of their vegetable acreage—about the same as our 2016 findings (see Figure 17). Twenty-seven percent of respondents reported using all organic seed for their vegetable crops, compared to 32 percent reported in 2016 and 20 percent in 2011 (see Figure 16). Across all respondents, the total vegetable acreage planted to organic seed increased slightly, to 35 percent (see Figure 18). Thirty-seven percent of vegetable producers also reported that they've increased the percentage of organic seed they're planting for vegetable crops compared to three years prior.

Field crops: In field crops, respondents reported planting about 70 percent of their organic field crop acreage with organic seed (see Figure 17). This is less than the reported 78 percent in our 2016 report. Fifty-eight percent of respondents are using all organic seed for field crops—about the same as we reported in 2016 (see Figure 16). Adding up the total acreage planted to organic field crop seed across all respondents, the fraction of total field crop acreage planted to organic seed remained about the same, at 56 percent (see Figure 18). We also found that 28 percent of respondents said they've increased the percentage of organic seed they're using over the last three years.

Cover crops: As with vegetable and field crops, on average, respondents reported planting 69 percent of their cover crop acreage with organic seed (see Figure 17). We also found that 56 percent of respondents are using all organic seed for their cover crops (see Figure 16) and that 28 percent of respondents who grow cover crops increased their percentage of organic seed over the last three years. These findings are all very similar to the cover crop figures in our last report. Adding up the total acreage planted to organic cover crop seed across all respondents, we saw a decrease in the fraction of the total cover crop acreage planted to organic seed, from 63 percent in 2016 to 42 percent in 2021 (see Figure 18). However, this was due to a single large operation using a low amount of organic cover crop seed.

Forage crops: Finally, for forage crops, on average, respondents reported planting 62 percent of forage crop acres with organic seed (see Figure 17), 62 percent said they are using all organic seed for these crops (see Figure 16), and 29 percent said they've increased the percentage of organic seed for forage crops over the last three years. Adding up the total acreage planted to organic forage crop seed across all respondents, the fraction of total forage crop acreage planted to organic seed remained about the same, at 50 percent (see Figure 18). All of these findings are very similar to both our 2016 and 2011 reports.

Figure 17. Average percent acreage planted to organic seed by crop



How does farm scale factor into organic seed usage?

Our most recent organic producer survey data shows a consistent decrease in the percent of organic seed used as vegetable acreage increases (see Figure 19). The data also points to less organic seed used by the largest (more than 480 acres) field crop producers. On the plus side, we saw an increase in organic forage seed usage by large (more than 160 acres) forage crop producers.

Data also points to larger scale vegetable producers (more than 50 acres of vegetable crops) identifying the following factors for not using organic seed more than other larger scale crop producers: lack of seed treatments, buyer requirements, and insufficient quantities of seed in organic form. The lack of specific traits in organic varieties was more of a factor for larger vegetable, field crop, and forage crop producers, and distrust of organic seed quality showed up as more of a factor for larger field crop producers (more than 80 acres of field crops).

How does organic seed usage compare across regions?

Organic vegetable seed usage was pretty consistent across regions, whereas organic cover crop seed usage was much lower in the West compared to other regions. Organic field crop seed usage was also lower in the West and South compared to the North Central and Northeast regions. Organic foliage seed usage was low in the West and higher in the North Central region.

Figure 18. Percent of total acreage planted to organic seed by crop

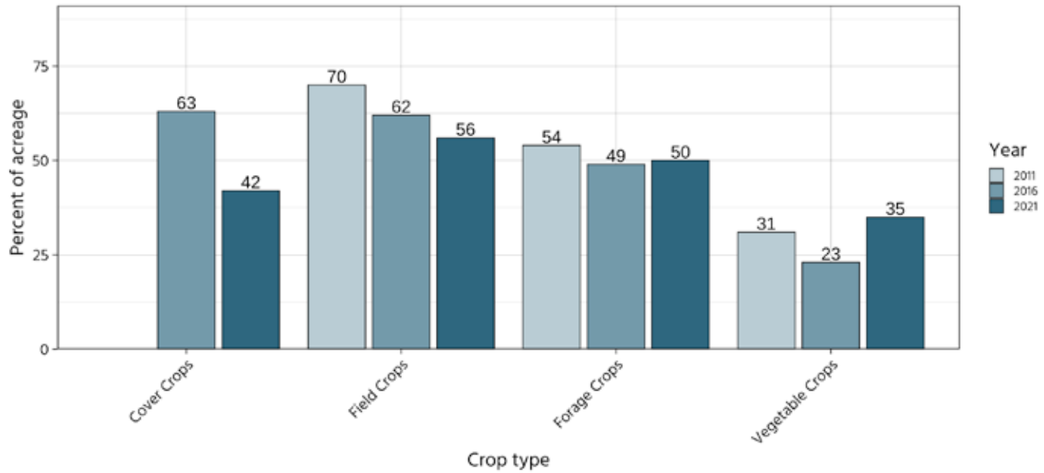
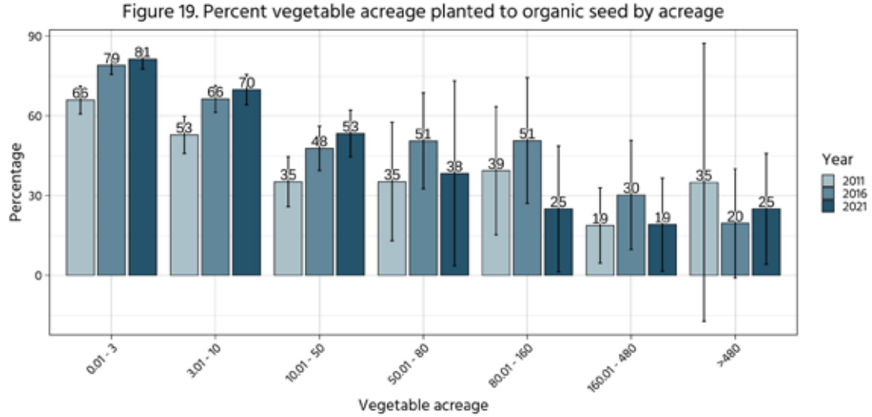


Figure 19. Percent vegetable acreage planted to organic seed by acreage



Where are organic producers sourcing seed?

There are a number of ways for organic producers to source seed—from online catalogs to next-door neighbors. Not surprisingly, seed companies stand out as the most relied upon source of organic seed for producers. We found that about 73 percent of the seed our survey respondents planted was sourced directly from seed companies through catalogs, websites, or sales representatives, representing an increase from our 2016 and 2011 reports (which were 57 percent and 71 percent, respectively). Respondents sourced the balance of their seed from their own production (13 percent), stores (5 percent), processors or buyers (6 percent), and other farmers (3 percent).

As reported in Chapter 2, fewer organic producers reported using their own seed compared to five years ago. Although these numbers have decreased since our last report, they still provide good evidence that a significant percentage of organic operations who responded to our survey are involved, or want to be involved, in seed work: 25 percent of respondents said they are using saved seed, 46 percent said they are producing seed for on-farm use or to sell commercially, and 40 percent said they're interested in producing seed commercially. This interest remains an opportunity for growing the number of skilled organic seed producers who can help increase and diversify the organic seed supply.

We would like to start selling organic seed but are unclear on how to do this starting on a small scale. ***– ORGANIC PRODUCER***

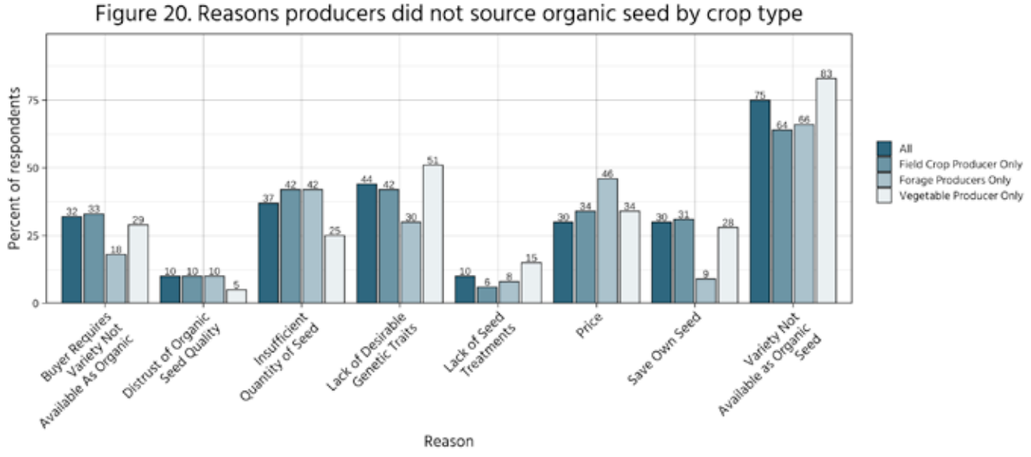
What factors impede organic seed sourcing?

Our survey asked organic producers to identify reasons for not sourcing more organic seed. In order of significance, the top reasons—reported as a "moderate" or "significant" factor—include: (1) a specific variety was unavailable as organic (75 percent of respondents), (2) a lack of desirable genetic traits in organic seed (44 percent), (3) insufficient quantities of seed for an organic variety (37 percent), and (4) a processor or buyer supplied non-organic seed or required a variety that wasn't available as organic (32 percent) (see Figure 20). Although price is not an allowable reason for sourcing non-organic seed, 30 percent of respondents indicated this was a factor. Thirty percent of respondents also said that seed saving was a reason for not sourcing organic seed. Much like we saw in our 2016 report, distrust of organic seed quality was not a significant factor when respondents sourced non-organic seed (21 percent).

Processors (buyers) demanding varieties in contract that are not available as organic continues to be the most significant roadblock to increasing use of organic seed in large row crop production. ***– ORGANIC CERTIFIER***

The reasons for not sourcing organic seed are generally consistent between crop types. The findings are also generally consistent with our 2016 data, though some minor differences stand out. In our most recent survey, fewer vegetable producers found seed quantities to be limiting their ability to source organic seed. We also saw more forage crop producers identifying price as a factor for not sourcing organic seed. And fewer forage producers found buyer/processor demands to be a factor in their seed choices.

Figure 20. Reasons producers did not source organic seed by crop type



Organic producers view organic seed as important to integrity

Even in the face of these challenges, the vast majority of organic producers responding to our survey (83 percent) believe organic seed is important to the integrity of organic food production. This finding hasn't really changed since our last report. Ensuring the organic seed supply continues to evolve to meet the diverse and regional needs of all organic operations, while staying true to critical principles and values, continues to be an overarching need moving forward.

When certifiers request that producers take extra measures to source more organic seed, these producers respond accordingly by increasing the percentage of organic seed they plant.

WHAT ROLE DO CERTIFIERS PLAY IN ORGANIC SEED SOURCING?

Organic certifiers and inspectors play an important role in fostering organic seed systems. Their jobs are to communicate the organic seed requirement to the operations they certify and inspect, to encourage increased organic seed sourcing when appropriate, and to share resources that help producers increase their sourcing of organic seed. Consistent enforcement of the organic seed requirement and encouraging measurable improvement is essential to accelerating the organic seed supply.

Through our organic producer survey, we found that only 35 percent of respondents said their certifier had requested they take greater steps to source more organic seed. This was similar to the 40 percent of respondents who stated this in our last report, and down significantly from 61 percent in 2009 (see Figure 21). Of the additional steps requested by certifiers, the most common were to research more than three seed catalogs, followed by using online seed databases.

Our data shows that when certifiers ask producers to take extra measures to source more organic seed, these producers respond accordingly. Figure 22 shows that, across crop types, producers who have had certifiers request extra measures increased the percentage of organic seed used. This finding underscores that consistent and strong enforcement of the organic seed requirement is important for increasing organic seed usage, while we also know that challenges loom large in this context. As we learned in our certifier survey (described below), it is difficult for certifiers to evaluate commercial availability. It is also difficult for organic seed companies to risk further investments in organic seed production when organic seed is more costly to produce and the exemption to source non-organic seed still exists.

Figure 21. Percent of growers reporting that their certifier requested greater steps to source organic seed

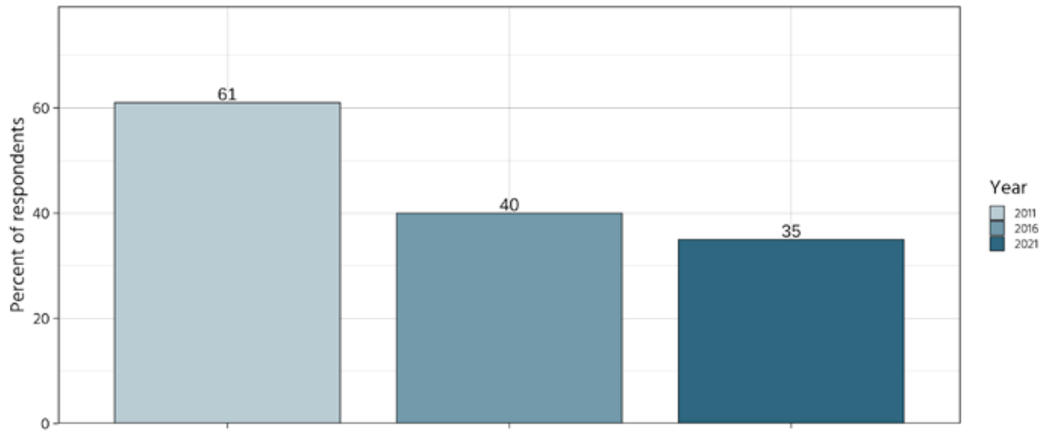
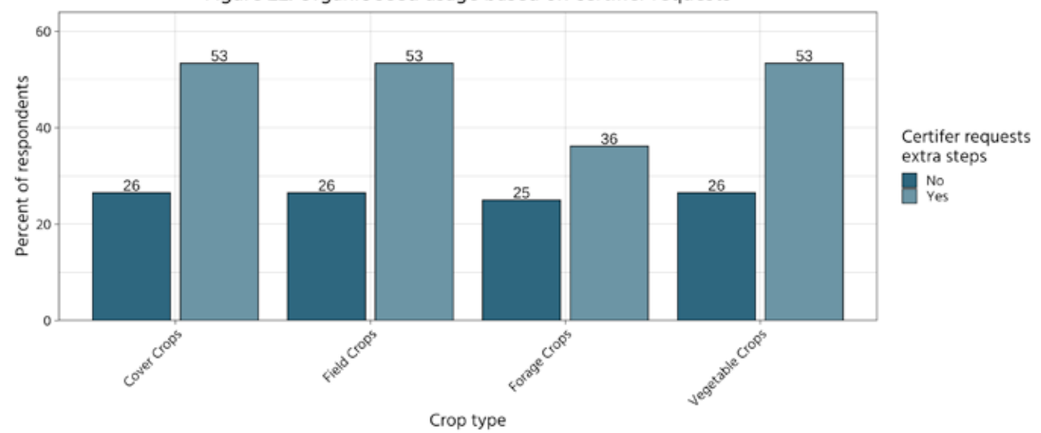


Figure 22. Organic seed usage based on certifier requests



THE ORGANIC SEED REGULATION

The current seed regulation requires organic growers to use organic seed unless the seeds they need, including equivalent varieties, aren't commercially available.* More organic seed sourcing leads to increased investments in organic seed production and breeding, strengthening the diversity of seed available and the overall integrity of organic products. Yet, most organic producers are still sourcing non-organic seed for at least part (if not all) of their operation.

To move the dial forward on organic seed sourcing, it's important to first understand that the National Organic Program, along with the organic certifiers they accredit, have powerful influence over the organic seed supply. While seed labeled as organic has a relatively short history, in two decades the market has gone from providing nearly no organic seed to hundreds of varieties, and offerings continue to grow.

The purpose of the current organic seed exemption is to provide a transition time for the seed industry to catch up to demand and to allow organic growers to find suitable varieties to transition to, with the goal of eventually achieving 100 percent organic seed sourcing. The allowance for non-organic seed is important for growers who lack access to appropriate organic seed for their operations. While it is no one's intention to force organic growers to use organic seed that may not be optimal for their operations, continuous improvement in organic seed sourcing is essential to incentivizing growth in the organic seed supply and strengthening organic integrity.

In the seed industry, some companies view increased investments in organic plant breeding and seed production as risky. These companies are reluctant to diversify and increase the volume of their organic seed offerings when non-organic seed—which is less costly to produce and therefore typically has a lower price tag—is still an option for organic growers. As one organic seed company explained:

One thing that I feel needs to be addressed is the loophole for growers. It is "abused" more than respected, from my experiences. What do I mean by this? A grower can ask three sources if they have whichever organic variety they're looking for, and if nobody has it, they can buy conventional seeds . . . This law needs to change, or I do believe that many companies will move on from this, since there currently isn't any accountability of enforcement.

ENFORCING THE ORGANIC SEED REGULATION

The exemption for organic growers to source non-organic seed is also challenging for organic certifiers and inspectors. Their role is to verify compliance with the requirement, but it is understandably difficult for certifiers and inspectors to monitor organic seed availability by crop type and region. Our data below underscores this challenge.

In 2020, OSA conducted a survey of accredited certifying agencies (ACAs) based in the US, and twenty-two certifiers responded.** We estimate that collectively these ACAs represent more than 80 percent of certified organic farms in the US. We sent a very similar survey to certifiers in 2015 and the same number of ACAs responded to that survey as well. The NOP has accredited more than 80 certifiers around the world, and more than 40 of these are based in the US. Survey questions ranged from ACAs' perspectives on organic seed sourcing to their enforcement of the organic seed requirement.

Certifier perspectives on organic seed sourcing

More than 70 percent of certifiers responding to our survey say they are seeing increased availability of organic seed in the market, both in terms of varieties and through a greater number of vendors. When asked about usage by crop type, certifier perspectives were generally in line with overall trends seen in our organic producer survey.

> *Most of our producers have access to regional seed companies that are making great increases in organic seed options and availability. We see this continuing given the market desire.* – ORGANIC CERTIFIER

* The regulations in 7 CFR § 205.204 state that producers "must use organically grown seeds, annual seedlings, and planting stock." Because the supply of organic seeds was inadequate when the NOP launched in 2002, the regulations provide a necessary exemption that allows producers to use untreated, non-GMO seed that hasn't been produced organically, stating: "non-organically produced, untreated seeds and planting stock may be used to produce an organic crop when an equivalent organically produced variety is not commercially available."

** We received twenty-five responses representing twenty-two certifiers. In two cases, more than one individual from the same certifier took the survey. The data included in this report represents all twenty-five individual responses.

For example, 60 percent of ACAs said that organic producers' use of organic vegetable seed has increased over the past three years, while 40 percent said their use had stayed the same. "It's incredibly hard to track organic seed usage in vegetable varieties, but we feel that usage is continually increasing," shared one respondent, while another said, "It depends on the scale of the operation." In field crops, only 24 percent of ACAs reported an increase in organic field-crop seed use over the past three years, while 72 percent said it had stayed the same and 4 percent thought it had decreased. As one ACA commented, "Increased usage does depend on the success of organic seed availability. Seed crop failures have had an impact, but generally we feel that organic seed usage is on an uptick. Alfalfa seed has been the most unreliable for farmers and the area we see decreased usage." In cover crops, 31 percent of ACAs reported that organic producers' use of organic cover crop seed had increased, while 65 percent said it had stayed the same and 4 percent reported a decrease. Several respondents noted gaps in organic cover crop seed availability.

Certifiers reported that producers are not taking extra measures to source more organic seed. In our 2015 survey, only 22 percent of certifiers agreed with the statement that "organic growers are making a greater effort to find organic seed." Similarly, our 2020 survey found that only 16 percent of certifiers agreed with the statement that "most organic producers go beyond three catalogs/sources to find organic seed."

> *We need to constantly reinforce that the grower needs to do more work to locate or trial organic seed.* – ORGANIC CERTIFIER

Certifiers were also asked what they believed the reasons were for producers to source non-organic seed instead of organic. Their responses matched those provided by organic producers, including: the specific variety was not available in a certified organic form, a lack of desirable genetic traits in organic varieties, an insufficient quantity of seed for an organic variety, and when a processor (buyer) demands varieties in contract that are not available as organic.

In the event an organic grower claims they are unable to source a specific variety as organic, 68 percent of ACAs said it is "unlikely" they can evaluate equivalent organic varieties on the market. "If we are aware of a type of seed on the market in organic form, we will do our best to inform clients, but knowing all the seeds on the market in an organic form is a little more challenging," shared one respondent. Others shared that they didn't have enough staff or time. "It is not realistic for a certifier to tell a grower which varieties are 'equivalent' and will work in their location," commented another.

As for solutions, more than half of certifiers (52 percent) relayed the need for more certifier and inspector trainings to understand seed issues from the farmer and/or seed producer perspective. Numerous certifiers also pointed to the need for a centralized database of organic seed. "Perhaps a national directory could be a help, but at this point we use private for-profit websites to determine availability," shared one certifier. Other comments regarding a database included, "A good, comprehensive database that is kept up to date would help," and, "A robust database of ALL organic seed out there would be helpful!" In addition to an organic seed database, 80 percent of certifiers agreed that additional education materials and outreach for organic producers would increase organic seed usage. Specifically, 84 percent of certifiers identified access to organic variety trial data as useful.

> *Over the past three years, I have seen more growers setting up their own small-scale trials to assess organic varieties.*
> – ORGANIC CERTIFIER

Encouraging organic seed sourcing compliance

As the availability of organic seed grows, more certifiers say they have revised their policies and procedures regarding organic seed sourcing over the last three years. Nearly half (48 percent) of respondents now encourage operations they certify to do one or more of the following: conduct trials of available organic varieties, research more than three seed catalogs, request seed in a timely manner, research the Organic Seed Finder website, and, to a lesser extent, contract organic seed production.

Even those ACAs who say they have not revised policies or procedures appear to be taking the organic seed regulation more seriously. In the words of one respondent, "We have been more encouraging of organic seed use and question commercial availability more strongly, but we have not made any official policy changes." Another shared, "[We] have not revised, but address seed compliance and sourcing more strictly than in [the] past." Another commented, "We intend to ensure our policies align with the ACA Best Practices document over the next several months" (see "Best practices for enforcing the organic seed requirement").

BEST PRACTICES FOR ENFORCING THE ORGANIC SEED REQUIREMENT

In April 2019, the Accredited Certifiers Association, a non-profit made up of ACAs that collaborate on education and policy recommendations to ensure consistent implementation of the organic regulations, published a document entitled "Best Practices for Improving Consistency with Organic Seed Search Requirements."[21] Two years later, these detailed best practices served as the foundation of a new NOP course published in October 2021. This course, "Organic Seed Searches" and others are available on the NOP Organic Integrity Learning Center and serve as critical resources for organic certifiers, inspectors, and others working in organic compliance.[22]

Most certifiers (84 percent) report that they have issued a notice of non-compliance when organic seed wasn't sourced. But as one certifier mentioned, "The growers are always able to give a reason for why organic seed was not commercially available, even if it may seem weak. There does not appear to be a lot of room for an ACA to challenge as long as they back it up with something."

Perhaps this and other challenges in enforcing the organic seed regulation are why most certifiers believe that stronger regulations are needed. Most ACAs (68 percent) disagreed with the statement that "stronger regulations that aim to strengthen enforcement of the organic seed requirement are NOT needed at this time." As one certifier commented, "People are not consistently enforcing the regs," while another shared, "Commercial availability is subjective and hard to verify/find staff power to verify at times." Another certifier said, "Not much is changing on its own, so there may need to be a change in the regulations to move this issue forward." And another respondent commented, "The [Accredited Certifiers Association] has done a good job with a best practices document, but that isn't binding like the regulations and guidance from NOP."

Most certifiers support stronger regulations that aim to strengthen enforcement of the organic seed requirement.

Thankfully, there has been movement on updating both the organic seed regulation and the accompanying guidance document for certifiers since our last report. These proposals and other seed policy issues are examined in the next chapter.

THE COVID-19 PANDEMIC SPURS HISTORIC SEED SALES

The COVID-19 pandemic created serious disruptions in food supply chains that led to product shortages and food security fears. These concerns, coupled with more people working from home and wanting to grow their own food, led to a rise in new gardeners. As a result, seed companies suddenly found themselves racing to keep up with historic demand for their products.

When the US declared a national health emergency in March 2020, seed companies felt the impacts immediately. Maine-based Johnny's Selected Seeds and Fedco Seeds scrambled to handle increased sales. Johnny's saw a 270 percent jump in orders, and Fedco Seeds hired more customer service representatives, increased the number of daily worker shifts, and began to source seeds from additional suppliers. Staff at Hudson Valley Seed Company found themselves dipping into their second- and third-year supplies to fulfill orders. Nature and Nurture Seeds, based in Michigan, experienced more than 400 percent growth in sales. High Mowing Organic Seeds saw a 97 percent increase in invoiced sales overall relative to the previous year. The actual demand was higher than that, but the 97 percent reflects what they were able to deliver in April and May 2020. The increase in demand continued through the rest of 2020.

Numerous seed companies had to close online ordering to fulfill orders, and some sellers prioritized sales to commercial producers over backyard gardeners. Shipping was also delayed due to both demand and slower-than-normal postal services. When seed purchasers were blocked from online ordering or saw that some varieties were out of stock, they concluded there was a major seed shortage. However, while some varieties were in short supply, the primary shortage was not so much seed but staff capacity for fulfilling orders.

Increased seed sales continued through 2021. "Judging by the volume of interest we're seeing now, it does make me feel like maybe it wasn't a temporary response,'" said Doug Mueller of Hudson Valley Seed Company. "There might be social change [happening]."[23]

(continued on next page)

THE COVID-19 PANDEMIC SPURS HISTORIC SEED SALES (CONTINUED)

"In late 2021, we were still well above where we were pre-pandemic," says High Mowing Organic Seeds Chief Marketing Officer, Andrea Tursini. "But the overall growth rates have slowed. A big part of the earliest surge came from home gardeners, but as pandemic life continued, we saw significant increases from commercial growers as well, both because they were concerned about perceived seed shortages, and also because their businesses were seeing a pandemic boom."

The Cooperative Gardens Commission (CGC), a grassroots initiative created in the spirit of World War "victory gardens," is evidence of this change. CGC works to increase community food production and access, with the primary aim of connecting those with food-growing resources—including seeds—with those who lack these resources. In their first year, CGC sent free seeds to 257 seed hubs across forty-one states, supplying 12,000 gardens in 2020. It has grown to over 400 local and regional hubs, reaching tens of thousands of people and distributing millions of free seeds that were mostly donated by small-scale and organic seed companies.

Heightened interest in seed saving provides more evidence of social change coming out of the pandemic. In a Civil Eats piece, Executive Director Emily Rose Haga of Seed Savers Exchange reported that in 2020 their number of new seed saver listings tripled and that requests from their seed bank were up 30 percent.

"One of the things that this pandemic has done is make people feel out of control," said Haga. "And what is more powerful and liberating than putting a seed into the ground, watching it grow, and then feeding yourself and your family or your friends?"[24]

TAKEAWAYS

- The organic standards require sourcing of organic seed when commercially available but most organic producers are still using non-organic seed for at least part (if not all) of their operation.
- Small-scale vegetable producers are sourcing more organic vegetable seed compared to previous reports, but we haven't seen significant changes in organic seed sourcing for vegetable growers over 50 acres or for field crops, cover crops, and forage crops. In each of these three latter crop categories there appears to be a stagnation—roughly 40 percent of producers report using about the same amount of organic seed compared to three years ago.
- Most organic producers source their seed directly from seed companies through websites, catalogs, and sales representatives, while a much smaller percentage source from their own production, stores, processors or buyers, and other farmers.
- Though fewer organic producers reported using their own seed compared to the previous report, a decent percentage of organic operations are still involved in seed work. A quarter of farmers are using saved seed, and nearly half are producing seed for on-farm use or to sell commercially.
- Growers report their top reason for not sourcing organic seed is that a specific variety was unavailable as organic, and certifiers have a hard time identifying what might be substituted as an equivalent variety per the organic seed regulation. We also saw an increase in organic producers reporting a processor/buyer requirement as a factor in not sourcing organic seed (more than 30 percent of respondents).
- Organic certifiers perceive that organic seed availability is on the rise, and they support stronger policies for enforcement of the organic seed requirement.
- Fewer producers report that their certifiers are requesting they take extra measures to source more organic seed, and our findings show that when certifiers encourage additional measures to source organic seed, these organic producers respond accordingly.
- Training organic certifiers, inspectors, and producers in organic seed availability and regulatory enforcement would likely improve organic seed sourcing, as would a reliable, national database that includes all commercially available organic seed.

CHAPTER 4

Organic Seed Policy

Policy work—lawmaking and rulemaking—impacts so much in our lives, including how seeds are cared for, managed, and distributed. From how much public funding is directed to public germplasm collections to the allowance of genetically engineered (GE) seeds in our fields and food, laws and regulations guide and influence seed systems and markets in many ways.

Throughout this report we have reflected on the challenges faced by plant breeders and researchers who aim to develop organic varieties, organic seed producers and companies fulfilling much of our organic seed supply, organic producers who are required to source organic seed, and certifiers charged with enforcing the organic seed regulation. What policy solutions are available for addressing these challenges and fostering decentralized and diverse seed systems? And what policy issues are of most concern to organic seed stakeholders?

In this chapter, we share a summary of organic seed policy actions that have occurred since our last report, followed by other policy updates and needs as they pertain to seed systems more broadly. The policy areas included in this chapter were identified as priorities by organic seed stakeholders through a 2020 policy survey of constituents in our database. This chapter aims to elucidate the importance of organizing around shared policy priorities identified by these stakeholders to ensure seeds are available organically, managed responsibly, and protected for future generations.

WHAT IS OSA'S VISION?

Currently, seed is largely managed as a privatized commodity—as opposed to a living resource that requires careful stewardship. Economic, ethical, and social issues loom large, including consolidation of market and political power, ownership claims on naturally occurring genetic traits, cultural appropriation of plants, underfunded public seed collections and plant breeding programs, and the failed experiment of coexistence between GE cropping systems and organic and other non-GE systems.

OSA envisions a future where organic seed is managed as a collective commitment to the common good. As part of this vision, growers would have adequate choice in seed free of restrictive forms of intellectual property rights and GE traits; Indigenous communities and other historically marginalized seed stewards would control if and when culturally important plants are shared; the seed industry would no longer be one of the most concentrated trades in existence; and public seed collections would serve the public good first, growing in capacity and diversity each year to serve as a foundation of a healthy and resilient food supply for future generations.

Seed policy matters. With a status quo built for industrial agribusiness, we need good public policy just to level the playing field. Good seed policy can help us build the just, sustainable, and resilient seed systems we need.

— Nate Kleinmann
EXPERIMENTAL FARM NETWORK

NATIONAL ORGANIC PROGRAM POLICIES

Policies directly guiding certified organic seed fall within the oversight of the USDA's National Organic Program (NOP). To date, discussions and actions under this umbrella have focused on three NOP policy areas: (1) the regulatory requirement for organic producers to use organic seed; (2) the excluded methods definition, specifically clarifying which breeding methods should be allowed in certified organic production; and (3) the need to monitor prohibited substances and excluded methods in organic processes and inputs, including avoiding GE traits in organic and other non-GE seed sources.

How can we move the dial forward on organic seed sourcing?

Since the NOP's inception, organic producers and seed industry members have relayed concerns about how the seed requirement would be interpreted and enforced. In 2013 the NOP published "Seeds, Annual Seedlings, and Planting Stock in Organic Crop Production" as a guidance document for certifiers. But ever since its publication, members of the organic community have requested that it be strengthened. The National Organic Standards Board (NOSB) responded to these requests in 2018 when it unanimously passed a recommendation to the NOP that included detailed ideas for improving this guidance document. Although guidance documents aren't legally enforceable, certifiers rely on them as a critical resource for interpreting and enforcing organic regulations.

The following year, the NOSB renewed attention to the organic seed regulation when it unanimously passed a proposal to update this language. If adopted by the NOP, their proposal will require organic producers to demonstrate improvement in sourcing organic seed and planting stock on an annual basis.* Together, these two actions represent a milestone. We view this evolution in organic seed policy as a significant step toward a future where the integrity of the organic label is stronger because the critical first link in the organic production chain—seed—is also consistently organic.

Getting clear on excluded methods

Another topic related to organic seed that the NOSB has taken on since our last report is excluded methods. While there is general agreement within the organic community that the existing definition (see "The excluded methods definition") is strong, as new breeding techniques emerge there has been a sense of urgency to clarify which of these methods align or conflict with the definition.

This topic came into sharp relief as various gene-editing techniques, such as CRISPR, expanded rapidly in plant breeding programs. While the NOP has publicly stated that gene editing is an excluded method (i.e., gene editing is a form of recombinant DNA technology), conversations around new techniques led to inquiries about other methods used in plant breeding—including organic plant breeding—that may or may not align with the excluded methods definition.

To guide these conversations, the NOSB passed a policy proposal in 2016 that provides a framework for evaluating old and new methods. Since that time, the NOSB has provided clarity on a dozen methods, ranging from synthetic biology to marker-assisted selection.** We hope the NOP will adopt these recommendations as part of a guidance document that can be updated regularly. Organic plant breeders, seed companies, producers, and certifiers all need clarity on excluded methods as the regulatory definition pertains to plant breeding and seed.

THE EXCLUDED METHODS DEFINITION

Per 7 CFR 205.2:

> Excluded methods: A variety of methods used to genetically modify organisms or influence their growth and development by means that are not possible under natural conditions or processes and are not considered compatible with organic production. Such methods include cell fusion, microencapsulation and macroencapsulation, and recombinant DNA technology (including gene deletion, gene doubling, introducing a foreign gene, and changing the positions of genes when achieved by recombinant DNA technology). Such methods do not include the use of traditional breeding, conjugation, fermentation, hybridization, in vitro fertilization, or tissue culture.

It's important to note that the methods currently listed as "to be determined" are not products of genetic engineering. Given that challenges and gray areas exist when evaluating which methods are appropriate for organic production and whether some can even be traced, and therefore regulated, there's a need to explore other paths for ensuring transparency and consistency in plant breeding methods used for the benefit of organic agriculture. For example, there is an opportunity for organic plant breeders to develop a voluntary organic breeding standard that embraces the ideals and expectations of both organic producers and the consumers they feed.

* The language recommendation passed unanimously by the NOSB in 2019 states:
(a) The producer must use organically grown seeds, annual seedlings, and planting stock: Except, That, (1) Nonorganically produced, untreated seeds and planting stock may be used to produce an organic crop when an equivalent organically produced variety is not commercially available: Except, That, organically produced seed must be used for the production of edible sprouts; (i) Improvement in sourcing and use of organic seed and planting stock must be demonstrated every year until full compliance with (a) is achieved.

** For more information about the NOSB's framework for evaluating excluded methods, including past decisions, see page 155 in their April 2021 meeting materials at https://www.ams.usda.gov/sites/default/files/media/NOSBProposalPacketApril2021.pdf.

The failed experiment of "coexistence" between GMO and organic

Genetically engineered seed has been planted in our fields and sold in the marketplace for more than twenty-five years, yet the food and farming community has a profound lack of knowledge on the state of genetic integrity of organic and other non-GE seeds. The USDA has not provided the farming community a transparent monitoring system for tracking GE crop plantings, either in the experimental field-trial stage or post-commercialization.

According to our surveys, both organic producers and the organic seed producers/companies supplying them believe that access to GE-free seed is important. The vast majority of respondents (72 percent) to our organic producer survey want seed companies to test and report GMO contamination levels in organic and untreated conventional seed. More than half of respondents (52 percent) to our seed producer/company survey say they test at least "sometimes," and 87 percent say that it is "very" or "extremely important" to offer organic and non-GMO seed with no or very low levels of GE traits. These findings demonstrate an understanding that GMOs have no place in organic production.

Interestingly, only 51 percent of organic producers said they don't think federal regulations overseeing GMO approvals are adequate for protecting their organic farm products from contamination by GE crops. This is a significant drop compared to the 71 percent of respondents in our 2016 report. We are unsure why there was such a big shift in this perspective.

Under existing policy, organic growers are already mandated to use non-GMO seed and to take precautions in the field—such as planting buffer zones—to avoid the presence of prohibited substances (e.g., pesticide drift) and excluded methods (e.g., GE pollen). There is no contamination prevention strategy required of growers or manufacturers of GE crops, so the burden of protecting organic integrity remains the burden of organic producers, including seed producers.

Organic farmers have been responding to the challenge of GMO contamination in a number of ways, including trying to mitigate gene flow in the field through planting practices. Many seed companies are testing at-risk seed (e.g., corn) and redirecting lots that exceed their internal company threshold to conventional markets. Still, organic grain growers have had loads rejected due to unexpected GE content, and there is no compensation mechanism to recoup these losses.

> *We save a lot of our own seeds to use the next year, and we are surrounded by conventional farms.*
>
> *And so with corn, specifically, we see a lot of cross-pollination with conventional corn. And so for us that means we spend a lot of time at the end of the season and into the winter sorting out all those corn seeds.*
>
> — ORGANIC PRODUCER

Since our last report, the NOSB's Materials Subcommittee has explored ways that organic policy can address GMO contamination. In 2019, the subcommittee proposed an approach that would have required organic field-corn growers to request the disclosure of detectable levels of GE content in the non-GE seed they source from seed companies. The proposal was well intentioned: to provide transparency in the seed marketplace and incentivize organic seed sourcing, while potentially collecting useful data. However, the proposal raised a number of concerns—including creating an undue burden on organic farmers—and in the end didn't move forward due to a lack of support from the organic community (see "How are seed companies dealing with GMO contamination?").

HOW ARE SEED COMPANIES DEALING WITH GMO CONTAMINATION?

In 2019, Organic Seed Alliance conducted a survey of major hybrid seed-corn providers supplying organic growers. The purpose of the survey was to better understand how seed companies selling certified organic and/or untreated conventional/non-GMO hybrid seed corn are monitoring and addressing GMO contamination levels in the seed they sell. Fifteen companies participated in the survey, representing the majority (more than 70 percent) of seed planted to organic field-corn acreage in the US.

Genetically engineered traits are of concern to many organic producers, grain buyers, and consumers of organic food because GE methods are excluded in certified organic production. Our survey questions focused on companies' testing practices, perspectives, costs, and experiences. Companies were also asked to weigh in on the NOSB's proposal from August 14, 2018 (see above) that would have required organic farmers to request information on detectable levels of GE traits in the seed corn they buy. Most companies did not support the proposal, pointing to increased production costs that would be passed on to farmers and fewer investments in organic seed production. Other survey findings included:

Seed companies understand the importance of genetic integrity

Most companies taking the survey (86 percent) said it's "extremely important" or "very important" to offer hybrid seed corn with no or very low levels of GE traits.

(continued on next page)

HOW ARE SEED COMPANIES DEALING WITH GMO CONTAMINATION? (CONTINUED)

Seed companies already field requests for testing data, but from a small customer base

All companies said they receive requests from their customers regarding detectable levels of GE traits in the seed they sell; however, most companies say these requests currently make up a relatively small percentage of their customer base. Ninety-two percent of respondents say these requests represent 20 percent or less of their sales.

Seed companies already spend tens of thousands of dollars each year on testing

Most companies spend more than $10,000 annually on testing for unwanted GE traits. Half of the seed companies responding spend between $10,000 and $50,000 per year. Two companies spend more than $75,000 per year. Nearly half of respondents say they spend more than $250 per test, with three companies spending more than $500 per test.

Seed companies say GE levels are variable and hard to predict year to year

More than half of the companies say contamination levels in organic and conventional/untreated hybrid seed corn have become more variable and harder to predict. Most respondents (60 percent) say their business has been financially harmed due to detectable levels of GE traits in the non-GE corn seed they sell, but that they have no recourse for recouping losses. These financial losses, coupled with the amount spent on testing, indicate that companies are already taking a financial hit to monitor and address contamination levels in the seed they sell.

Some seed companies are willing to participate in a baseline data-collection effort

It's encouraging to know that 60 percent of companies responding say they are willing to share testing data with an independent body of experts under a non-disclosure agreement to help the organic industry better understand patterns in detectable levels of GE traits in seed by crop type.

The subcommittee had a difficult time identifying a solution within the framework of organic policy for this reason: The source of GMO contamination does not originate within organic production. In other words, preventing the problem will require prevention strategies on the part of those who produce and profit from GE crops, in addition to oversight by the agency charged with regulating them—largely the USDA. Unfortunately, neither party is willing to move toward shared responsibility in protecting organic growers from GMO contamination.

Perhaps most disappointing was the USDA's missed opportunity in mandating contamination prevention as part of the agency's 2020 update to its biotech regulations—the first since they were developed in the late 1980s. The USDA is one of three agencies that regulate GMOs, along with the Environmental Protection Agency and Food and Drug Administration. When GE crops entered the lab and our fields, US policymakers chose to rely on a patchwork of existing laws, many of which predate the technology, instead of creating a new law to oversee these novel organisms. This resulted in a mishmash of agency interpretations for regulating GMOs that left many holes: the absence of mandatory GMO labeling, post-market monitoring, and a mechanism for compensating non-GMO growers harmed by contamination, to name a few. Lacking a robust regulatory framework, each agency has, in different ways, abdicated their regulatory responsibility.

When the USDA published its new rule in May 2020, the updated regulations continued an abdication of regulatory responsibility. The new rule automatically deregulates a huge swath of GE plants, claiming they pose no additional concerns due to the similarity of the breeding methods and genetic material to those found in nature. The new approach to regulating GMOs is now largely voluntary, where manufacturers determine whether to bring their new products to the attention of regulators or not. In July 2021, six organizations filed a lawsuit challenging USDA's new rules, saying they violate several federal statutes, as well as the agency's constitutional directive to regulate plant pests and noxious weeds.[25]

The lack of regulatory oversight and data collection means the new rules will discourage transparency in what new GE crops are entering the market and will obscure potential risks, making it more difficult to identify problems if they arise. Furthermore, the new rules nearly guarantee that the burden of prevention and the consequences of contamination will remain the burden of organic seed and food producers who must strive to avoid GMOs to meet customer expectations.

GMO CONTAMINATION AND THE CROSS-INCOMPATIBILITY STRATEGY

Genetic contamination occurs when genetically engineered plants pollinate conventional plants and introduce GE traits into the resulting cross. Corn is highly susceptible to GE contamination due to its open-pollinated nature and several human and environmental factors.

Gametophytic cross-incompatibility (CI) is a naturally bred genetic trait in corn that allows a plant to selectively breed only with plants that have the same gene that confers this cross-incompatibility trait. This is an incredibly effective breeding strategy for protecting organic and other non-GE corn against contamination. The popcorn industry also greatly relies on this trait to protect the integrity of popcorn types from crossing with different corn types, such as field and sweet corn.

Pioneer Hi-Bred, a leading player in the seed industry, has developed a corn seed blend in which one of the seed types contains both a CI trait and a GE trait. Combining the two would effectively remove this strategy from organic plant breeders' toolbox, as it would open the floodgates for widespread contamination, since GE corn expressing a particular CI gene could easily cross with organic plants expressing the same gene—and in so doing, accept the GE trait.

The proposed combination of CI and GE traits threatens to undermine decades of careful research and organic plant breeding. At the time of this writing, seed companies were in discussion on how best to protect the genetic integrity of crops that include and rely on CI traits.

BEYOND THE NOP: POWER IN SEED POLICY

Beyond NOP seed policy, organic seed growers still operate within the same power dynamics and political systems as any other seed grower, be they organic, conventional, or even GMO. Policy areas outside of the NOP are important to understand, monitor, and take action on since a significant amount of organic seed is currently produced and distributed through systems that were built for the conventional seed industry.

Intellectual property rights

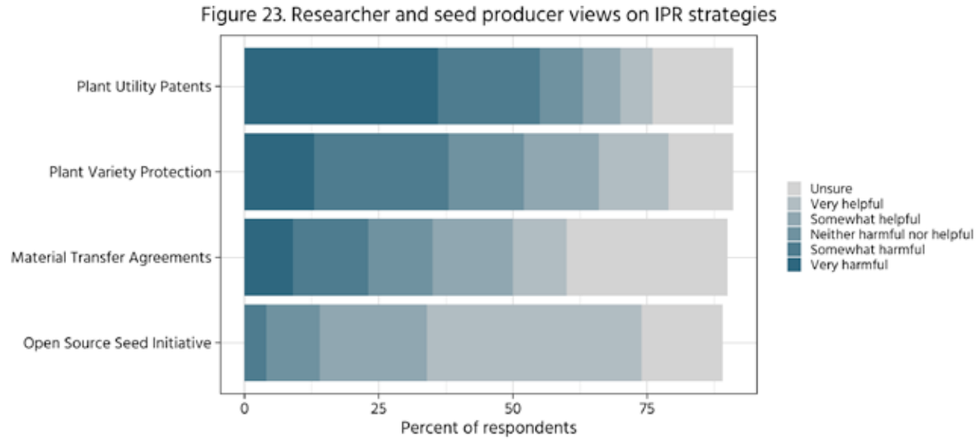
Intellectual property rights on seed are of critical concern to plant breeders, seed producers, and the communities they feed. It has only been over the course of a few decades that highly restrictive forms of IPR have expanded. One of these tools—utility patents (i.e., patents for invention)—were generally first awarded for products of genetic engineering. Today, utility patent owners brazenly claim ownership to thousands of non-GMO plants and traits, from finished lettuce varieties to phenotypes ("pink tomatoes") and genetic traits ("heat-tolerance").[26]

OSA'S POSITION ON UTILITY PATENTS

Organic Seed Alliance does not support the utility patenting of life, including seeds, plants, and genetic traits. We believe that other forms of IPR—such as PVPs and fair licensing agreements—are more suitable for providing protections and royalties to developers of varieties. In other words: Utility patents are the wrong tool for "protecting" seed. Indeed, one consequence of utility patents is quite the opposite—utility patents put the diversity and viability of our seed commons, and our ability to co-evolve with our food crops, at risk.

commercially are not. As we learned in Chapters 1 and 2, organic researchers and organic seed producers both have concerns about IPR mechanisms, especially utility patents (see Figure 23 for a summary of these findings). Resistance to utility patents on seed is especially strong within the organic movement. In fact, in its excluded methods recommendations to the NOP, the NOSB recommends against IPR measures that restrict seed saving and research.*

Figure 23. Researcher and seed producer views on IPR strategies



* "The exchange of genetic resources is encouraged. In order to ensure farmers have a legal avenue to save seed and plant breeders have access to germplasm for research and developing new varieties, the application of restrictive intellectual property protection (e.g., utility patents and licensing agreements that restrict such uses to living organisms, their metabolites, gene sequences, or breeding processes) are refrained from." See: NOSB, Materials/GMO Subcommittee Proposal, "Excluded Methods Determinations," August 13, 2019, https://www.ams.usda.gov/sites/default/files/media/MSExcludedMethodsProposaFall2019.pdf.

There are alternatives to utility patents, such as licensing agreements, that can be used in fair and reasonable ways, adhere to the principles of open access and shared benefit, and protect seed saving and breeding rights. These and other tools can also serve as a form of resistance to highly restrictive IPR and harmful practices associated with them, such as onerous restrictions, high licensing fees, cultural appropriation, criminalized seed saving, fear of unintentional patent infringement, and more.

Concentration and antitrust

The expansion of both GMOs and restrictive IPR on seed have facilitated rapid and extensive consolidation in the seed industry. As one example, GE varieties were introduced in 1996, and within two years, the companies selling them had accelerated consolidation by buying up smaller firms to accumulate more IPR and to homogenize the marketplace. As a result, by 2008, Monsanto's patented genetics were planted on 80 percent of US corn acres, 86 percent of cotton acres, and 92 percent of soybean acres. Today, these percentages are even higher.[27]

"We need more seed producers. A little competition helps with quality and prices. – ***ORGANIC PRODUCER***

Since our last report, three of the most historic seed-industry mergers have occurred. The "Big Six" (Monsanto, DuPont, Syngenta, Dow, Bayer, and BASF) have now consolidated into the "Big Four" dominated by Bayer and Corteva (a new firm created as a result of the Dow-DuPont merger), and rounded out with ChemChina and BASF (see "Mega-mergers in the seed industry between 2016 and 2021"). These four firms control more than 60 percent of global proprietary seed sales.

MEGA-MERGERS IN THE SEED INDUSTRY BETWEEN 2016 AND 2021

- **Dow and DuPont:** This $130 billion merger resulted in the two chemical companies dividing into three companies, including a new agriculture firm called Corteva.
- **ChemChina and Syngenta:** This $43 billion merger allowed China to add its second company ranking in the top 10 of global seed sales (along with Longping High-Tech).
- **Bayer and Monsanto:** This $63 billion deal was the second-biggest merger announced in 2016; Bayer has since dropped Monsanto's 117-year-old name and cut 12,000 jobs (10 percent of its workforce), despite promising new jobs as part of the merger.

While the three mergers above received the most media attention and public resistance, there were 56 additional acquisitions and joint ventures involving other top seed companies in 2018 alone. These included Limagrain's Vilmorin-Mikado subsidiary in France and Longping High-Tech in China, which acquired Dow's maize division in Brazil. Both ChemChina and Longping High-Tech are planning more acquisitions of seed companies in China. The Department of Justice required Bayer to sell its large vegetable seed arm, Nunhem's, in order to acquire Monsanto. Nunhem's is now owned by BASF (one of the Big Four).

Economists say that an industry has lost its competitive character when the concentration ratio of the top four firms is 40 percent or higher. The seed industry continues to exceed this benchmark across the entire global supply and within crop types as well. For example, even before the Big Four merged, three firms (Monsanto, Syngenta, and Vilmorin) controlled 60 percent of the global vegetable seed market. When Bayer purchased Monsanto, it acquired several large vegetable seed companies, including Seminis and DeRuiter. In 2021, Bayer announced it would soon release its first organic vegetable seed line (see "Bayer moves into organic seed").

BAYER MOVES INTO ORGANIC SEED

In 2021, Bayer CropScience, which acquired Monsanto and its vegetable businesses in 2018, announced a new line of organic vegetable seeds for the greenhouse industry. This news provides more evidence that the organic food market is large, growing, and successful. For decades, organic was not worth the investment of the largest seed companies—now it is.

What does this mean for organic? Is this yet another development that risks dividing the organic community, or is it an opportunity to realign with the founding principles of the organic movement?

For a long time, organic set itself apart from the dominant consolidated food industry, but an increasing degree of concentration among organic companies highlights the need to recommit to an alternative path.[28] As an industry that is still maturing, organic seed producers and the farmers they support have an opportunity to create a path for organic seed that is distinct from the chemical/biotech seed sector—to serve as an alternative to this level of concentration. To achieve this distinction, we all must advocate for the necessary policies, practices, and systems that allow for decentralized organic seed systems to not only blossom, but to flourish and thrive.

How did this level of concentration happen? Weak antitrust law enforcement and oversight by the US Department of Justice (DOJ) has allowed a handful of firms to amass enormous market, economic, and political power over our global seed supply. Consolidation reduces seed options and drives up prices, allowing the handful of top industry players to push products and policies that perpetuate an unsustainable system with little to no concern for public or environmental health.

Fortunately, the Biden administration is trying to re-establish strong antitrust law enforcement. In 2021, the White House published an ambitious Executive Order tackling consolidation in agriculture and other key industries.[29] The order reasserts the government's authority to challenge deceitful and harmful corporate practices in an era of extreme monopolization in agricultural markets, including seed.

Biden's plan duly targets patents as a driver of consolidation, directing the US Patent and Trademark Office to investigate and prepare a report outlining the anticompetitive effects of seed patents and potential solutions. The body of precedent supporting the practice of granting utility patents on seeds is surprisingly thin: the legislative histories of the Plant Patent Act and Plant Variety Protection Act show that Congress expressly considered—and twice rejected—overly restrictive grants of power over new varieties. Seeds became patentable thanks to a novel interpretation from a narrow majority of justices on the Supreme Court, who in 1980 decided that GMOs were not "products of nature" but rather human inventions.

USDA Secretary Vilsack missed an opportunity to address industry consolidation and the egregious use of seed patents during his first tenure as Secretary of Agriculture under the Obama Administration.[30] In 2010, the USDA and DOJ launched an historic initiative to hear from the public about agricultural competition concerns. They hosted listening sessions across the US, the first being in Ankeny, Iowa. Unfortunately, the agencies took very little action. In 2021, Secretary Vilsack found himself in Ankeny once again and announced that the administration was looking at consolidation within the seed industry. The Secretary said he understood that seed companies want to see a return on their investment in new technology but that the "pace of change" could mean lengthy patents don't make sense.[31]

Another way the USDA can help ensure more choice in the seed marketplace is by increasing funding for public plant breeding programs that fill market gaps unmet by the private sector, as we'll explore next.

Public plant breeders who focus on releasing new varieties to growers in their region are an important part of seed system development.

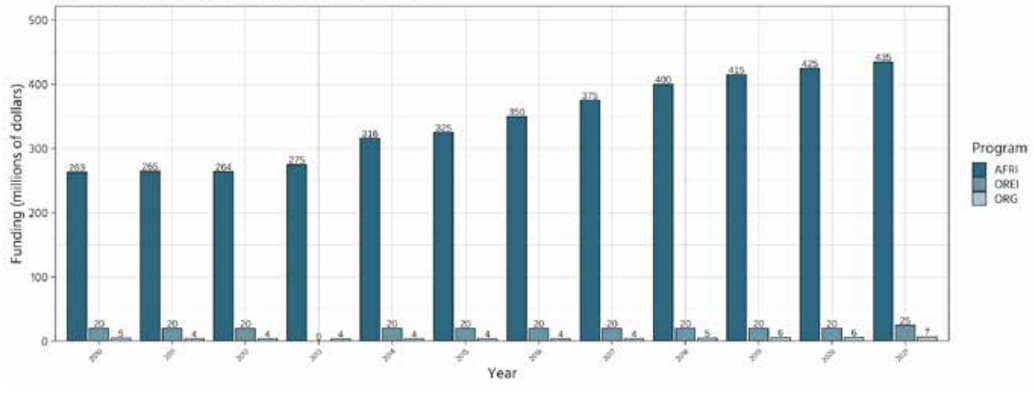
Public plant breeding capacity

Public plant breeders who focus on releasing new varieties to growers in their region are an important part of seed system development. These publicly funded programs are charged with serving the public good first, which means they are well positioned to address underserved crop and market needs, including organic. There continues to be growing interest among public breeders and students in organic plant breeding and other organic seed research. Perhaps this is most evident when looking at our research investment findings in Chapter 1, where most of the USDA's Organic Agricultural Research and Extension Initiative grants have gone toward organic plant-breeding projects at public institutions.

Fortunately, the 2018 Farm Bill more than doubled funding for the OREI program thanks to the advocacy efforts of the Organic Farming Research Foundation and others. This is especially important given that public support for public plant-breeding programs has waned over the years, and public cultivar development in particular is in a state of decline.[32] Funding these programs continues to be a challenge, as we found through our researcher survey in Chapter 1, as is access to germplasm due to overly restrictive licensing agreements.

Despite increased OREI funding, Figure 24 shows that organic agriculture research investments are not keeping pace with other agricultural research investments. Organic research typically benefits all growers, whether certified or not, but the same can't be said about conventional agriculture investments, where chemical inputs or methods not allowed in organic production are often part of research goals or processes. While the USDA has made significant changes in its priorities for competitive plant breeding grants—changes that include creating a separate funding stream for public cultivars—there is much more the agency and universities can do to increase dollars going toward new plant varieties that address the diverse and regional needs of organic growers and their markets.

Figure 24. USDA investments in AFRI, OREI, and ORG programs from 2010 to 2022 (data provided by the National Organic Coalition)



TAKEAWAYS

- To date, the NOSB has focused seed-related policy recommendations on three areas: strengthening the organic seed requirement and improving the guidance document on organic seed searches for certifiers, clarifying plant breeding techniques that either align or conflict with the regulatory definition of "excluded methods," and navigating organic growers' challenges with GMO contamination in the seed they source.

- Since our 2016 report, the NOSB has unanimously passed several proposals in these policy areas, including recommendations to strengthen both the organic seed regulation and guidance document on organic seed searches. The NOSB also passed a proposal that establishes a framework for evaluating new and existing breeding techniques in the context of the excluded methods definition and has made recommendations on more than a dozen methods in question.

- GMO contamination remains a concern of organic producers and seed producers/companies, but organic policy solutions are difficult to identify given that true "coexistence" is only possible when manufacturers and users of GMO crops share responsibilities and strategies for preventing contamination of organic and other non-GE seed.

- Because organic seed is largely produced within the same power dynamics and political systems as other commercial seed, policy areas outside of the NOP are important to understand and monitor in order to influence the economic, ethical, and social issues that loom large in our seed systems, including the interrelated issues of market consolidation, antitrust, and IPR.

- Public plant-breeding programs help fill market gaps unmet by the private sector, including in organic seed, but more public investments are needed to ensure these programs remain viable and responsive to the needs of growers in their regions.

Conclusion and Recommendations

Seed is the fundamental starting point of most food, representing an entryway for furthering the founding principles of the organic farming movement: fairness, care, health, and ecology. The seed that sustains us today is a result of the co-evolution of people and plants, along with the exchange of seed between generations, cultures, and continents. Organic seed carries with it these histories and requires careful management to keep seed diversity alive and growing for future generations.

Certified organic seed is a requirement of certified organic production—the highest-integrity food production standard available to consumers. Through this market lens, organic seed becomes integral to transforming our food and agricultural systems. Organic production encourages climate-friendly practices that build soil health and biodiversity while excluding fossil fuel-based synthetic pesticides and fertilizers, chemically treated seed, and GMOs.

Because the benefits of planting and sourcing organic seed go beyond meeting a regulatory requirement, prioritizing progress toward 100 percent organic seed usage in certified organic production is urgently needed. Yet, as our latest findings show, we are seeing no meaningful progress toward more organic seed being planted compared to five years ago.

Through surveys, interviews, and other assessments described in this report, our data points to the following recommendations for advancing organic seed systems from the perspectives of research, funding, seed policy, and regulatory enforcement. Our hope is that these recommendations serve as a roadmap for seed communities and the broader organic movement to advance organic seed for the common good.

PUBLIC RESEARCH AGENDAS AND FUNDING

- **Public research investments in organic plant breeding and seed initiatives should continue to increase while diversifying who participates in research.**

Public investments play an important role in supporting and shaping organic research agendas, and so we must continue to pay attention to the funds provided and the projects supported. First and foremost, organic research funding should continue to match the size of the organic market, especially through long-term funding, to keep pace with organic demands and the staffing and capacity needs required by programs to conduct robust research. Public plant-breeding programs help fill market gaps unmet by the private sector, including in organic seed, but more public investments are needed to ensure these programs remain viable and responsive to the needs of organic growers in their regions.

The seed-producer needs identified in this report should be considered for funding allocation to ensure that organic funding is supporting organic breeding as well as seed production and non-production needs.

Organic research funding should continue to prioritize organic plant-breeding projects while also ensuring a more diverse range of research agendas. Seed producers' primary challenge is the production of seed: estimating and achieving yields; controlling weed, pest, and disease pressure; and managing climatic effects. Outside of production, managing business activities, finding markets, developing infrastructure, and finding and retaining skilled labor all rank high on the list of challenges. These challenges require more public research and capital investment. Furthermore, economists, engineers, social scientists, community development scholars, and other disciplines should be brought into organic seed research projects.

- **Public research programs need to prioritize historically marginalized growers and their communities.**

Funding programs need to diversify applicants, review panelists, and awardees to better address historically under-represented communities of seed growers and stewards. Funding should support organic researchers who use participatory models with Black, Indigenous, and other people of color (BIPOC) in culturally effective and efficient strategies for conserving crop genetic diversity and for developing varieties of use and importance on BIPOC farmlands. Relationships with 1890 land grant institutions should be

strengthened to promote organic seed strategies and pathways to cultural food security and farm sustainability.

- **A broader range of governmental funding sources should support public cultivar development—funding should not over-rely on USDA OREI.**

Public organic cultivar development could be funded through opportunities outside of the USDA OREI program, including the Organic Transitions Program (ORG), the Agriculture and Food Research Initiative (AFRI), as well as programs outside the USDA, such as the National Science Foundation (NSF) and National Institutes of Health (NIH). Ensuring the growth and success of our public plant-breeding programs will also help ensure that experienced plant breeders are able to train the next generation of breeders who are enthusiastic about supporting organic and agroecological food and farming systems.

- **Researchers should continue collaborative models to ensure meaningful engagement and relevant project deliverables.**

Our data shows that collaborative research is on the rise. Participatory plant breeding is gaining traction, and more than three-quarters of researchers identified research collaborations with stake-holders. Researchers should continue this model, moving from knowledge delivery to knowledge co-creation through collaborative projects.

- **Develop investment models outside existing federal programs that support research and infrastructure needs of smaller organic seed producers/companies.**

In addition to expanding existing programs and funding opportunities for organic plant breeders and organic seed producers, models that are more accessible for smaller seed producers/companies are needed. Having equipment and resources that fit their scale of production is a central challenge, pointing to the need for programs that support these kinds of operations. Opportunities such as small grants for technical assistance and cost-share programs could help address some of the key challenges that seed producers identify.

- **Align research priorities with the principles underpinning the organic movement to ensure that transparency, equity, and justice are central tenets of public investments.**

As investments in organic plant breeding and organic seed increase, the organic principles are a necessary touchstone for ensuring that seed systems embrace diversity, health, and fairness as they grow alongside the success of the broader organic industry. One idea is for public and private plant breeders to collaborate on a voluntary organic plant breeding standard that embraces the ideals of organic growers and consumers alike. This standard could highlight the principles underpinning organic agriculture and help breeders commit to practices that align not only with the excluded methods definition but go further to embrace collective agreements in the organic community about non-GMO methods and IPR. As stated in this report, organic seed should be defined by what it embraces and represents, not only by what it excludes.

- **Address data gaps in the report, including a survey of seed producers/companies not represented by current data and market data on commercial availability of organic seed.**

Dozens of seed companies that are independent from the "Big Four" were not targeted by our seed producer/company survey because they currently produce very little to no organic seed. Surveying these mid-size companies would help us better understand existing interests and barriers to entering or expanding organic seed production to help fill organic seed supply gaps.

- **Train more organic seed producers and support existing producers.**

Limited resources and training were identified by organic producers as barriers to entering or expanding organic seed production. More region-specific training and resources could increase the number of organic seed producers in a variety of crops and regions, and at different scales.

- **Improve existing, or develop a new, database that reliably includes all commercially available organic seed to support sourcing and enforcement, including eventually closing the exemption that allows organic producers to use non-organic seed.**

The biggest data gap in our State of Organic Seed project continues to be market data on the commercial availability of organic seed. A comprehensive, reliable database of organic seed—or a regular market assessment—would help organic producers source more organic seed and support certifiers in enforcing the organic seed requirement. Furthermore, a comprehensive database would help regulators and advisors, including the NOSB, understand supply gaps and strengths to inform a strategy and timeline for eventually closing the allowance of non-organic seed by crop type and possibly region.

- **Explore a feedback loop to identify which varieties organic producers cannot find in an organic form.**

Because variety unavailability is identified as producers' top reason for not sourcing organic seed, a feedback loop that involves organic producers, organic seed producers/companies, and even certifiers is needed to identify supply gaps and stimulate production.

- **Train organic certifiers, inspectors, and producers in organic seed availability and regulatory enforcement to improve organic seed sourcing.**

The lack of progress in organic seed usage over the last five years provides a sense of urgency in furthering strategies to support increased organic seed sourcing. The role of regulatory agencies and certifiers is an important part of the strategy for making more progress toward 100 percent organic seed usage. Stronger regulations and guidance from the NOP would help, as would additional resources and training for certifiers and inspectors on the state of organic seed and best practices for enforcing the seed regulation.

POLICY RECOMMENDATIONS

- **The organic seed regulation should be strengthened and consistently enforced.**

The NOP should adopt the NOSB's recommendations to strengthen both the organic seed regulation and the certifier guidance document on organic seed searches. Certifiers should encourage producers who don't demonstrate improvement in organic seed sourcing year to year to take extra measures to source organic seed, such as going beyond three catalogs and conducting variety trials.

- **The barrier of processor/buyer seed requirements needs to be addressed.**

Our data shows that processor/buyer seed requirements are increasingly a barrier to sourcing organic seed, and that the largest operations are still using relatively little organic seed. Organic handlers, and the large producers who contract with them, should be required to support increased organic seed sourcing, including planning ahead with organic seed suppliers if desired varieties and quantities are currently unavailable in an organic form. Organic producers have little (if any) control over their seed choices when growing under these arrangements, and therefore outside regulatory pressure is needed.

- **The NOP should adopt the NOSB's recommendations to date on excluded methods.**

The NOP should adopt the NOSB's recommendations on excluded methods, including a proposal that established a framework for evaluating new and existing breeding techniques in the context of the excluded methods definition. The NOSB has made recommendations on more than a dozen methods to date. These proposals should be adopted by the NOP and turned into a guidance document for the organic industry that can be updated as new methods emerge.

- **The NOSB should develop recommended guidance on GE testing for certifying agencies and the organic industry.**

The NOSB should develop recommended guidance for certifiers and the broader organic industry on how to test for GE material in seeds and crops to support the genetic integrity of organic products.

- **The USDA should implement policies and actions that prevent GMO contamination of organic seed.**

These actions should include holding patent owners of GE crops accountable for harm that results when prevention measures fail. The organic community should no longer solely shoulder the burden of prevention practices and costs, and the consequences of contamination. The USDA

should also initiate a task force to collect baseline data on detectable levels of GE traits in organic and other non-GE seed. This data would help the organic community better understand detectable levels and trends in seed and would help inform future policy proposals.

- **Policy action on climate change is urgently needed to support the future of organic seed systems**.

  Climate change is already severely impacting organic seed growers, and policy actions and research investments are needed to mitigate the impacts and increase the climate robustness of our crops and seed systems.

- **The Organic Certification Cost Share Program should be restored to its original funding level and continually expanded to match ongoing growth in producers seeking certification.**

  In 2020, the USDA Farm Service Agency (FSA) announced a reduction in cost share from 75 percent of eligible certification costs with a maximum of receiving $750 down to 50 percent of fees for a maximum of $500. FSA should reinstate the full organic certification cost-share reimbursement to support growers who rely on this support and to lower this barrier to entry for new organic producers. Certification costs were flagged as a challenge by several organic seed producers/companies.

- **The National Plant Germplasm System should ensure that funding for germplasm collections increases for the benefit of the public good.**

  NPGS was one of the most popular sources of germplasm for the organic producers we heard from, indicating the value of this centralized, publicly funded source of genetic diversity. In addition to ensuring that seed collections are kept alive and growing through increasing funding and capacity, clarification of how these collections are managed and shared is needed. Equity concerns have been raised around cultural appropriation, proper acknowledgement, and the potential privatization of both the public domain and seeds held within historically marginalized seed communities. NPGS should address these concerns by involving diverse stakeholders in conversations about how to store and share seed, including the original stewards of the seed in the collections. Policies and procedures should provide proper acknowledgement and distribution to ensure transparency, access, and accountability within germplasm collections.

- **Organic seed stakeholders should advocate for policy initiatives that aim to decentralize power in agriculture and advance equity and justice within food and farm policies, programs, and leadership**.

  By working together, policy partners can address the need to dismantle institutional racism in the organic community and beyond that has excluded Black, Indigenous, and other people of color (BIPOC) from access to seed, land, financial resources, organic certification, political standing, and educational and professional trajectories. This includes supporting policy change that allows BIPOC communities to shape their own food system, beginning with culturally appropriate seed and foodways.

- **Congress and regulators should examine and confront the concentrated ownership of seed through antitrust investigations, policy change, and other actions**

  The "Big Four" seed companies control over 60 percent of the commercial market share. Concentrated market power increases prices, reduces choice in the marketplace, and squeezes out competitors. Market concentration and the increased privatization of seeds have narrowed crop genetic diversity in our fields and resulted in an overemphasis on breeding for major crops and large-scale agriculture. Strong antitrust law enforcement can slow concentration in the seed system and stimulate competition and innovation. Addressing concentration concerns also requires an examination of IPR associated with seed.

- **Intellectual property rights (IPR) on seed should be examined and reformed, and protection strategies that further fairness and shared benefit should be promoted.**

  The DOJ, USDA, and Congress should examine the tension between IPR law and antitrust law, as restrictive forms of IPR have facilitated rapid and extensive consolidation in the seed industry. In particular, we believe the Plant Variety Protection Act (PVPA) should serve as the strongest IPR tool for protecting sexually reproducing plants; indeed, this was Congress's intent when the PVPA was passed in 1970. Patent law should be reformed to exclude living organisms, including seeds, plants, plant parts, and genetic traits. Most seed producers/companies and public researchers who responded to our survey questions on IPR view utility patents as the most harmful strategy being employed.

References

1. Organic Trade Association, *US Organic Industry Survey 2021*, accessed January 13, 2021, https://ota.com/market-analysis/organic-industry-survey/organic-industry-survey.
2. Huber, Bridget, "Report: Fertilizer resprt-fertilizer-responsible-for-more-than-20-percent-of-total-agricultural-emissions/.
3. Food and Agriculture Organization, "Why Bees Matter," May 20, 2018, https://www.fao.org/3/i9527en/i9527en.pdf.
4. Gillam, Carey, "'There's a Red Flag Here': How an Ethanol Plant Is Dangerously Polluting a U.S. Village," *The Guardian*, January 10, 2021, https://www.theguardian.com/us-news/2021/jan/10/mead-nebraska-ethanol-plant-pollution-danger.
5. USDA, *2017 Census of Agriculture*, October 2019, https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/Organics_Tabulation/organictab.pdf.
6. Ibid.
7. Edith Lammerts van Bueren and James R. Myers, *Organic Crop Breeding* (Oxford, UK: John Wiley & Sons, 2012).
8. Ibid.; M.R. Colley, et al., "Exploring the Emergence of Participatory Plant Breeding in Countries of the Global North—A Review," *Journal of Agricultural Science* 159, no. 5-6 (July 2021), https://doi.org/10.1017/S0021859621000782.
9. Kevin M. Murphy, et al., "Evidence of Varietal Adaptation to Organic Farming Systems," *Field Crops Research* 102 (2007), 422, https://digitalcommons.unl.edu/usdaarsfacpub/422; A.C. Shelton and W.F. Tracy, "Recurrent Selection and Participatory Plant Breeding for Improvement of Two Organic Open-Pollinated Sweet Maize (Zea mays L.) Populations," *Sustainability* 7, no. 5 (2015), https://doi.org/10.3390/su7055139.
10. "The Culture of Organic Today, Who Buys Organic and Why," The Hartman Group, June 2, 2020, https://www.hartman-group.com/newsletters/1291505642/the-culture-of-organic-today-who-buys-organic-and-why.
11. Lammerts van Bueren, Organic Crop Breeding.
12. Ibid.
13. Candace Pollock-Moore, "Breeding a Better Butternut," December 10, 2021, https://southern.sare.org/news/butternut-squash-virginia-breeding-sustainable-agriculture/.
14. Colley, "Exploring the emergence," 1–19.
15. Learn more about these injustices in the following:
    R. Lee and T. Ahtone, "Land-grab Universities," *High Country News*, April 1, 2020, https://www.hcn.org/issues/52.4/indigenous-affairs-education-land-grab-universities.
    J. Melvin, "Black Farmers Win $1.5 Billion in Discrimination Suit," *Reuters*, February 8, 2010, https://www.reuters.com/article/us-usa-farmers-pigford/black farmers-win-1-25-billion-in-discrimination-suit-idUSTRE61H5XD20100218.
    V.R. Newkirk, "The Great Land Robbery," *The Atlantic*, September 2019, https://www.theatlantic.com/magazine/archive/2019/09/this-land-was-our-land/594742/.
16. Lynn Curry, "'They Are Growing Things that Can't Be Replaced': Extreme Wildfires in Western Oregon Threaten Valuable Seed Supplies. They May Take Over a Tear to Recover," *The Counter*, September 22, 2020, https://thecounter.org/oregon-wildfires-threaten-valuable-seed-supplies-recovery-climate-change/.
17. United States Department of Agriculture, *The National Plant Germplasm System*: 2019 Status, Prospects, and Challenges, March 25, 2019.
18. Personal communication, September 18, 2020.
19. Rally, Inc., "Preventive Care in America: Understanding America's Health in a COVID-19 World," October 2020, https://d362armbx6l2g0.cloudfront.net/Rally_Media-Deck_Preventive-Care-in-America-2020_FINAL_10.8.20.pdf; Goldschmidt, Bridget, "COVID-19 Spurs Even Greater Interest in Organics," *Progressive Grocer*, June 10, 2020, https://progressivegrocer.com/covid-19-spurs-even-greater-interest-organics.
20. Packaged Facts, "Gen Z and Millennial Consumers Naturally Favor Organic Foods and Beverages," *PR Newswire*, January 7, 2020, https://www.packagedfacts.com/about/release.asp?id=4514.
21. Accredited Certifiers Association, "Best Practices for Improving Consistency with Organic Seed Search Requirements," April 2019, https://www.accreditedcertifiers.org/wp-content/uploads/2019/05/ACA-Best-Practices-for-Improving-Consistency-in-Organic-Seed-Search-4.30.2019-Final.pdf.
22. USDA-NOP Organic Integrity Learning Center, https://www.ams.usda.gov/services/organic-certification/training.
23. Lisa Held, "The COVID Gardening Renaissance Depends on Seeds—If You Can Find Them," *Civil Eats*, February 22, 2021, https://civileats.com/2021/02/22/the-covid-gardening-renaissance-depends-on-seeds-if-you-can-find-them/.
24. Held, "COVID Gardening."
25. Center for Food Safety, "Conservationists and Farmers Sue Over Trump Administration Removal of Most Genetically Engineered Organism Regulation," July 26, 2021, https://www.centerforfoodsafety.org/press-releases/6417/conservationists-and-farmers-sue-over-trump-administration-removal-of-most-genetically-engineered-organism-regulation.
26. Kiki Hubbard and Cathleen McCluskey, "How Patents Threaten Small Seed Companies," *Civil Eats*, September 11, 2020, https://civileats.com/2020/09/11/op-ed-how-seed-patents-threaten-small-seed-companies/.
27. USDA Economic Research Service, "Adoption of Genetically Engineered Crops in the U.S.," accessed December 1, 2021, https://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us/.
28. See Dr. Phil Howard's work on consolidation in the organic processing sector at https://philhoward.net/2017/05/08/organic-industry/.
29. The White House, "Executive Order on Promoting Competition in the American Economy," July 9, 2021, https://www.whitehouse.gov/briefing-room/presidential-actions/2021/07/09/executive-order-on-promoting-competition-in-the-american-economy/.
30. "Public Workshops: Agriculture and Antitrust Enforcement Issues in our 21st Century Economy," accessed January 14, 2021, https://www.justice.gov/atr/events/public-workshops-agriculture-and-antitrust-enforcement-issues-our-21st-century-economy-10.
31. Donnelle Eller and Brianne Pfannenstiel, "Tom Vilsack, in Iowa Visit, Says Biden Administration Will Look at Consolidation in Seed Industry," *Des Moines Register*, October 20, 2021, https://www.desmoinesregister.com/story/money/agriculture/2021/10/20/tom-vilsack-seed-industry-consolidation-joe-biden-administration-deere/6111624001/.
32. Adrienne Shelton and William Tracy, "Cultivar Development in the U.S. Public Sector," *Crop Science*, August 28, 2017, https://www.researchgate.net/publication/317107097_Cultivar_Development_in_the_US_Public_Sector.

Appendix A: Methods

FARMER SURVEY

In 2019/2020, we conducted a national survey of certified organic producers in partnership with Organic Farming Research Foundation (OFRF) and Washington State University's (WSU) Social and Economic Sciences Research Center (SESRC). The survey was designed based on the Tailored Design Method (TDM) model of social science survey principles, practices, and protocols. It was reviewed for protection of human subjects by the WSU's Human Subjects Institutional Review Board (IRB) and was certified exempt. The survey was broad in scope to inform OFRF's National Organic Research Agenda and the organic seed questions mirrored our past State of Organic Seed surveys. The seed questions aimed to capture attitudes and perceptions regarding organic seed, current use of organic seed, and any obstacles that restrict organic seed sourcing. The survey also asked which crops and traits should be prioritized through organic plant breeding programs. Many additional topics were covered in this survey. We asked similar questions in surveys for our 2011 and 2016 reports, allowing us to publish data comparisons in this report.

A sample of 2,000 certified organic producers was randomly selected from the National Organic Program (NOP) list. The survey was offered as both an online version and a paper questionnaire, and respondents had the option of completing either. After an initial postcard invitation, non-respondents received follow-up contacts by mail, email, and phone. The survey was open from December 2019 to June 2020. We received 206 completed or partially completed web surveys as well as 242 paper questionnaires. The final response rate for the random sample was 22.5 percent. Following the random sample survey initiation, the survey was also distributed as an open-access, convenience web option to all certified operations. OFRF and OSA contacted the remaining members of the NOP list and broadly advertised the survey. We advertised the survey through our respective organizational email contacts, social and traditional media, and through organic certifiers and organic farming membership organizations. The open-access convenience survey was open from February to September 2020, with 611 respondents completing or partially completing the survey. For the purposes of this report, the responses from the random sample of certified producers were combined with the responses from the open-access, convenience survey, resulting in 749 completed survey responses and 310 partially completed responses for a total of 1,059 responses.

Where possible, we included results from the 2021, 2016, and 2011 surveys. Not all questions could be compared, however, because we didn't include the question in one of the two surveys or because we asked the question in a different way.

Regional comparisons were made by grouping responses according to the four SARE regions as follows:

Western: CA, OR, WA, ID, NV, AZ, UT, NM, CO, WY, MT, AK, and HI

North Central: ND, SD, KS, NE, MN, IA, MO, WI, IL, MI, IN, and OH

Southern: TX, OK, AR, LA, KY, TN, MS, AL, FL, GA, SC, NC, and VA

Northeast: WV, MD, DE, NJ, PA, NY, CT, RI, MA, VT, NH, and ME

We calculated the response means and error using the base functions and the survey package in the R statistical programming language. The reference population sizes were based on the reported number of certified producers in 2009, 2014, and 2019, which were 10,903, 14,093, and 14,217, respectively. The confidence intervals (error bars) in the results report the range that the true result would be expected to be 95 percent of the time. In general, when there are fewer responses included in an average or percentage, the error is greater. This would happen either when we had fewer overall responses to a question or when we divided the responses into many categories with relatively few respondents in each category. The error can also be large when respondents provided very different answers from one another. The error bars can be used to determine how likely it is that the averages or percentages differ from one another; for example, the responses from 2021 and 2016, or the responses from large and small vegetable producers. If the error bars overlap, then we can't be sure the averages or percentages are actually different.

CERTIFIER SURVEY

In 2020, we distributed a survey to all accredited certifying agencies (ACAs) in the U.S. The survey invitation was sent via email and the data was collected through SurveyMonkey. OSA made follow-up requests by email and phone to ensure a good response rate. In the end, 25 individuals representing 22 certifiers responded. (More than one individual responded for two of the ACAs.) Our data analysis includes all 25 responses. Collectively, we estimate that the 22 ACAs represent more than 80 percent of certified organic farms in the US. The survey helped us understand how the organic seed requirement is being enforced, the challenges ACAs face in enforcement, and their ideas for how to make enforcement more consistent. This survey was also a method for our 2016 report, allowing us to publish data comparisons in this report.

SEED PRODUCER AND COMPANY SURVEY

We conducted a formal survey of organic seed growers and organic seed suppliers. The purpose was to better assess the challenges and opportunities in growing the organic seed industry, understand what they perceive as their "seed networks," and identify research priorities. We heard from 88 seed producers and 39 companies that range in scale and size.

Survey population

We gathered seed producer contact information from the NOP's INTEGRITY database. The database was queried for certified organic growers with organic products (June 2020) and organic crops (July 2020). We reviewed the contacts to identify growers with "seed" in their crops or products and manually coded to categorize crop and product categories. These data were combined with two lists from OSA. One was a list of contacts that likely contained seed producers and another was an expertly generated list of seed company contacts. These lists were compared and redundancies removed, resulting in a list with 416 seed producers and 90 seed companies.

Survey development and distribution

Surveys were developed by Zystro, Hubbard, and Wood during the summer and fall of 2020, with feedback from a sample of pilot survey-takers in each group. The surveys included questions that asked respondents to describe their operation, the challenges they face in their role, the crops they work with and breeding priorities, the people or organizations they use as resources in their networks, their personal definition of "resilience", and their perceptions on climate change and intellectual property rights. Seed producers and seed companies had largely similar surveys, though some differences were made to account for the different roles of these stakeholders. Surveys were hosted on the Qualtrics survey platform and distributed over email, with individual links for each respondent. Producer surveys were distributed between October and December 2020 and company surveys were distributed between January and March 2021. Each potential respondent was sent an initial email invitation with three reminders, spaced out every two to three weeks. Phone calls were randomly made to producers for the third reminder to increase response rates. Seed producers who took the survey were eligible to win one of ten $100 Visa gift cards.

Sample representativeness

Of the 416 seed producers contacted there were 88 full responses from organic seed producers for a response rate of 21 percent. Of the 90 seed companies contacted there were 39 full responses for a response rate of 43 percent. Together there were 127 responses out of 506 seed producers and companies, for a 25 percent response rate. Regionally, the response rate was 22 percent from the North Central region (20 of 92), 23 percent from the Western region (67 of 293), 29 percent from the Southern region (10 of 35), 32 percent from the Northeast region (17 of 54), 20 percent from Canada (3 of 15), and 20 percent from those with unidentifiable locations (3 of 14).

Data cleaning & analysis

We combined the seed producer and companies surveys for analysis. Respondents were asked about their operation and challenges and perceptions on key issues. We summarized responses using R Statistical Software. We also read the individual definitions of resilience (an open-ended question) and manually coded them for major themes using NVivo qualitative coding software. Responses about seed producer and companies networks were manually cleaned and used to create a database of all seed stakeholders, which allowed for the mapping and analysis of the organic seed network.

RESEARCHER SURVEY

We conducted a formal survey of organic seed researchers. The purpose was to better understand the successes, challenges, and opportunities for organic seed research, as well as researchers' perspectives on key issues. We heard from 51 researchers, 43 from universities and 8 from organizations.

Survey population

Researchers were identified based on their receipt of organic research grants, participation in OSA research programs, recent publications on organic seed, and through a snowballing survey method. Thirty-four recipients of organic research grants between 2016 and 2020 were identified through online searches. The grants included in the online searchers included SARE, OERI, NIFA, OFRF, and CERES. Nine researchers were identified based on past research with OSA. Furthermore, Web of Science was used to identify academic papers published between 2016 and 2020 that used variations on key words relating to seed, breeding, and organic production, which identified five more researchers. And we asked these survey respondents to identify other researchers they collaborate with on these projects, adding another 29 researchers. In total, 77 researchers were identified, 65 from universities and 12 from governmental and non-governmental organizations.

Sample representativeness

Of the 77 researchers contacted there were 51 full responses (8 from organizations and 43 from universities) for a response rate of 66 percent. Regionally, the response rate was 70 percent from the North Central region (16 of 23), 52 percent from the Western region (11 of 21), 70 percent from the Southern region (14 of 20), and 78 percent from the Northeast region (17 of 53).

Survey development and distribution

Surveys were developed by Zystro, Hubbard and Wood during the summer of 2021, with feedback from a sample of pilot survey-takers in each group. The surveys included questions that asked respondents to describe their most recent organic-related research project, the expertise they have in their role, the crops they work with and breeding priorities, the people or organizations they use as resources in their networks, their personal definition of "resilience," and their perceptions on climate change and intellectual property rights. Surveys were modeled after the organic seed producer and company surveys, but adjusted for relevance to the respondents. Surveys were hosted on the Qualtrics survey platform and distributed over email, with individual links for each respondent. Researcher surveys were distributed between September and December 2021. Each potential respondent was sent an initial email invitation with three reminders, spaced out every two to three weeks. Researchers who took the survey were awarded $40 awards in the form of cash, gift card, or donation.

RESEARCH INVESTMENTS ANALYSIS

To locate public organic seed and breeding initiatives, we examined lists and databases of the following programs and foundations: the USDA Organic Research and Education Initiative (began as IOP and became OREI), USDA Agriculture and Food Research Initiative (AFRI), the USDA Sustainable Research and Education program (SARE), the federal Risk Management Agency (RMA), the USDA Value Added Producer Grants program (VAPG), and federal and state Specialty Crop Grants. Additionally, we searched the USDA Current Research Information System (CRIS) for projects outside of the above listed programs. Search terms included "organic" combined with "trial," "breed," "seed," "variety," "cultivar," or "germplasm."

Project funding was divided in six ways: by year, by funding source, by project type, by crop type, by region, and by project budget. When calculating funding for multi-year projects, we considered total funding to be evenly distributed into all of the years in the project's term. Funding sources were divided into seven categories: USDA-OREI, SARE, other federal funds, Clif Bar Family Foundation, FAFO, OFRF, and other non-federal funds. We split the projects by topic into breeding/variety trials, enterprise development, seed production research and education, policy and systems development, and multi-topic. We also split projects into the four SARE regions (Western, North Central, Southern, and Northeast) and multi-regional. By crop type, we divided projects into vegetables, field crops, forage and/or cover crops, and other/multiple. Finally, we divided projects into the following total project budgets: less than $5,000, $5,000 to $10,000, $10,000 to $50,000, $50,000 to $100,000, and more than $100,000.

Appendix B: Producer Survey

Figure 1. Map of respondent locations

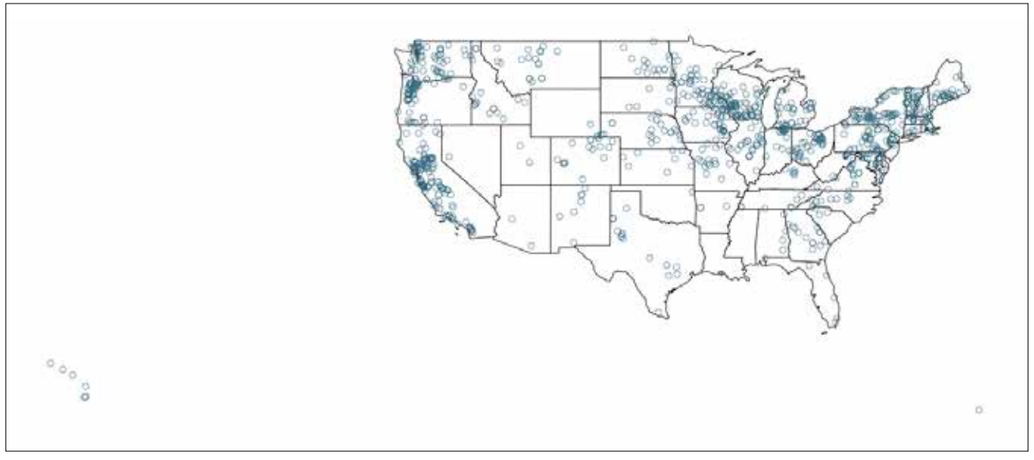


Figure 2. Respondents by region

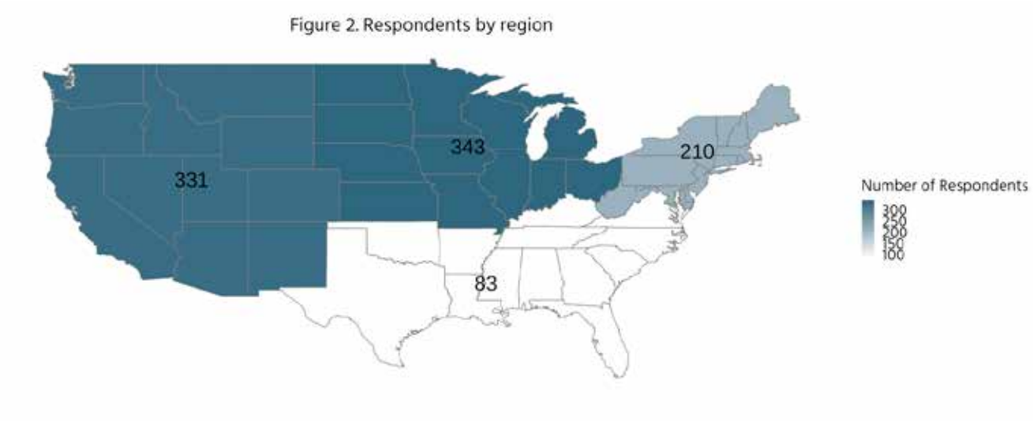


Figure 3. Years certified

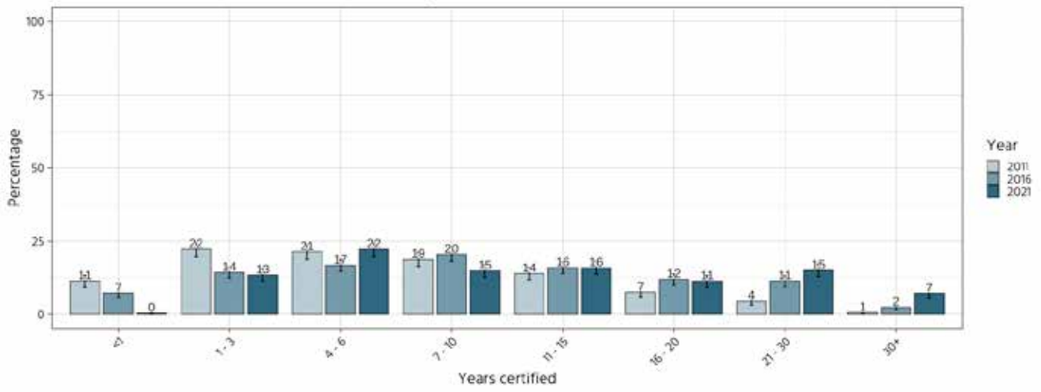


Figure 4. Percentage of respondents who produce vegetables

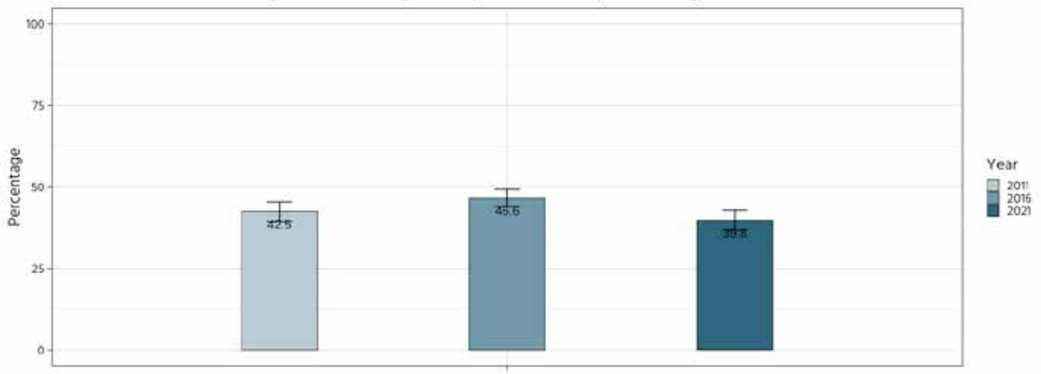


Figure 5. Vegetable acreage

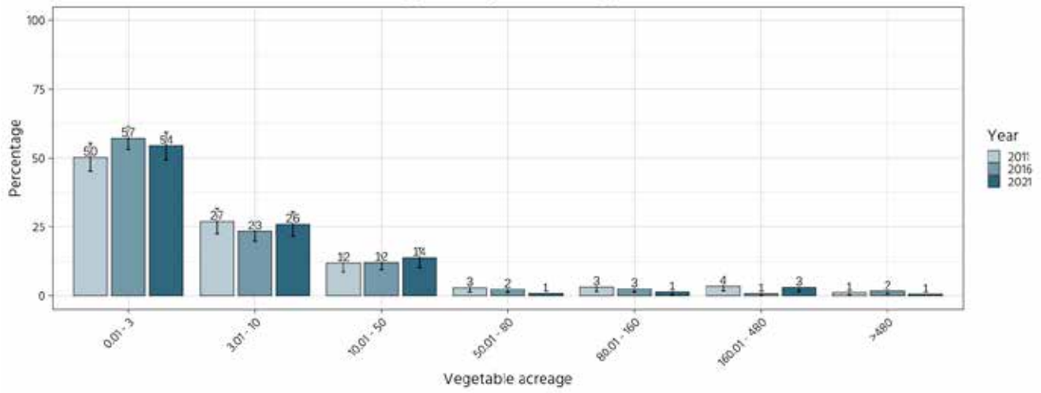


Figure 6. Percentage of respondents who produce cover crops or green pasture

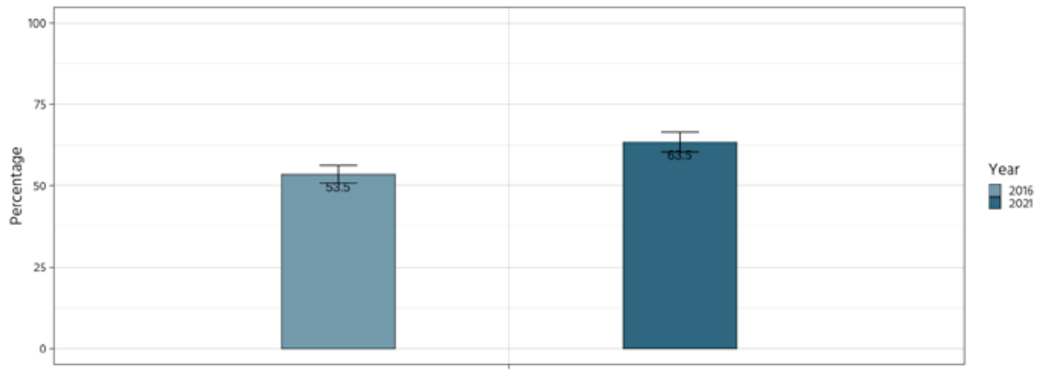


Figure 7. Cover crop acreage

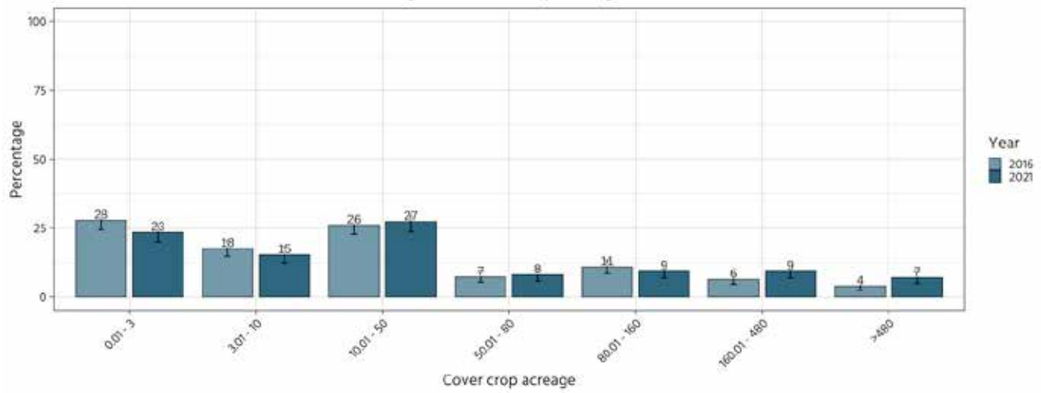


Figure 8. Percentage of respondents who produce field crops

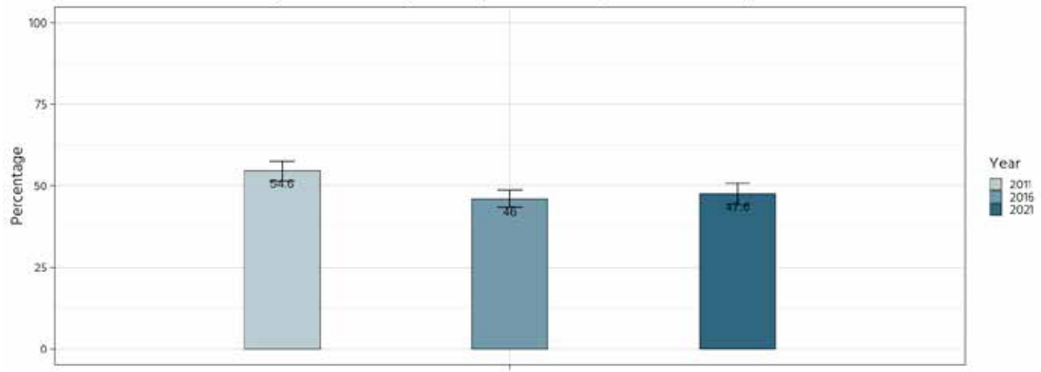


Figure 9. Field crop acreage

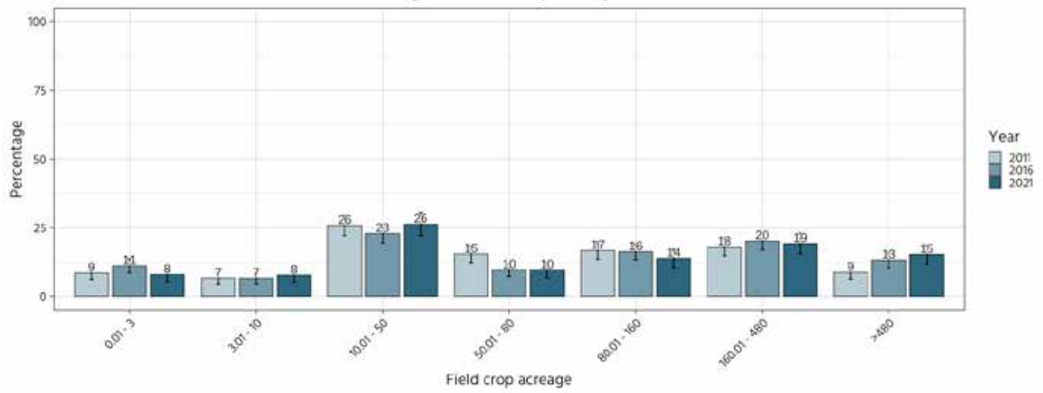


Figure 10. Percentage of respondents who produce forage crops

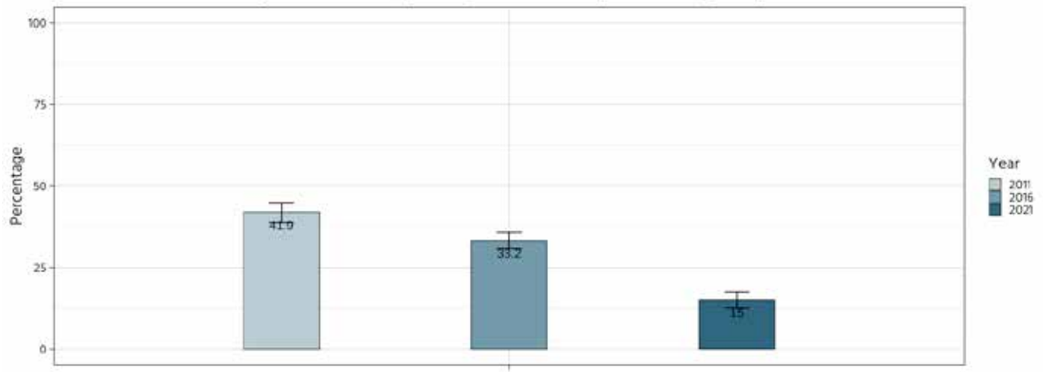


Figure 11. Forage crop acreage

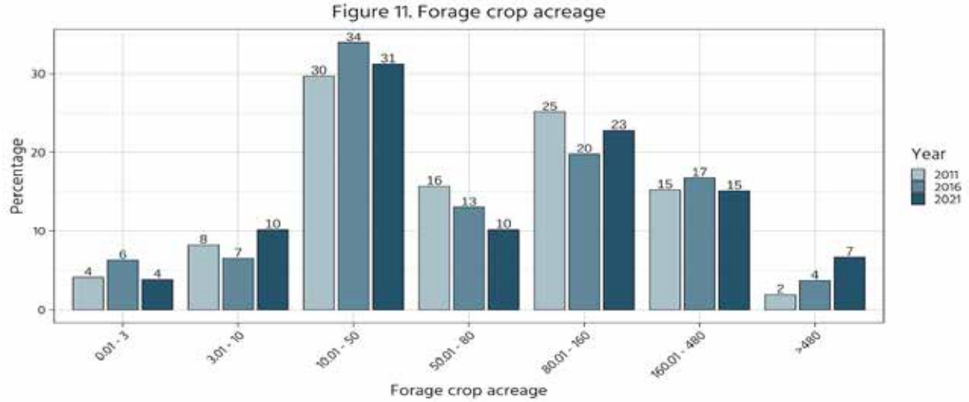


Figure 12. Percent vegetable acreage planted to organic seed

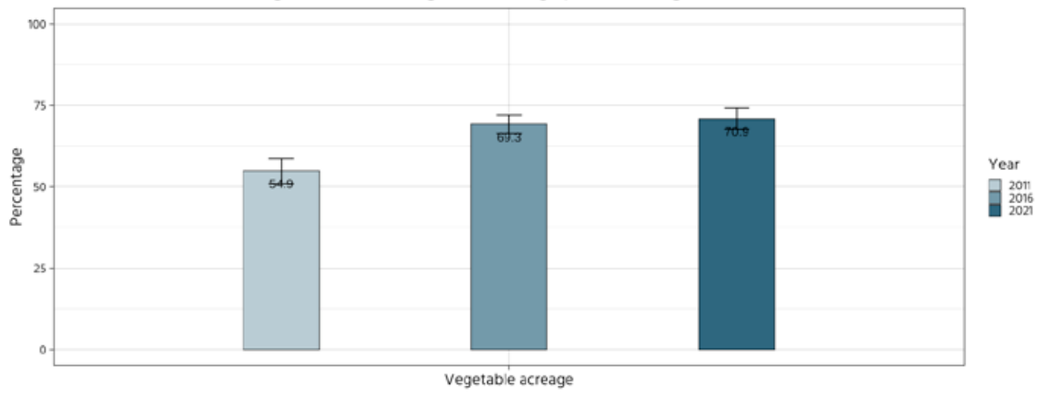


Figure 13. Percent vegetable acreage planted to organic seed

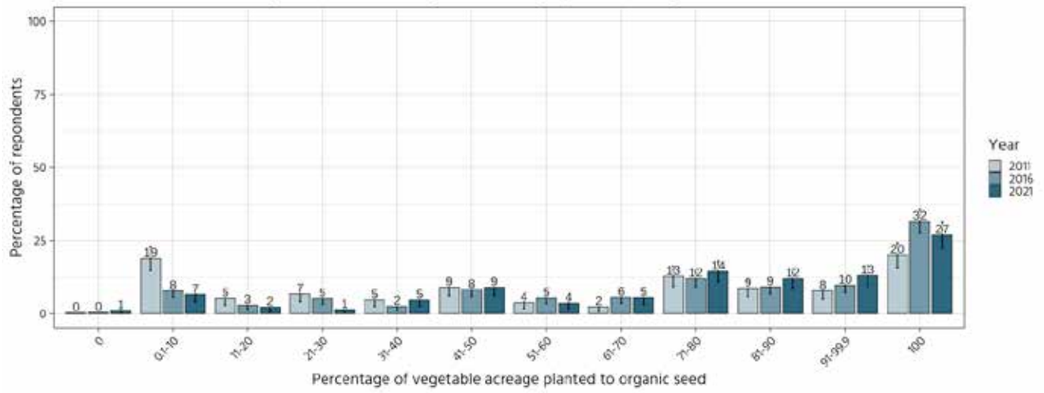


Figure 14. Percent vegetable acreage planted to organic seed by acreage

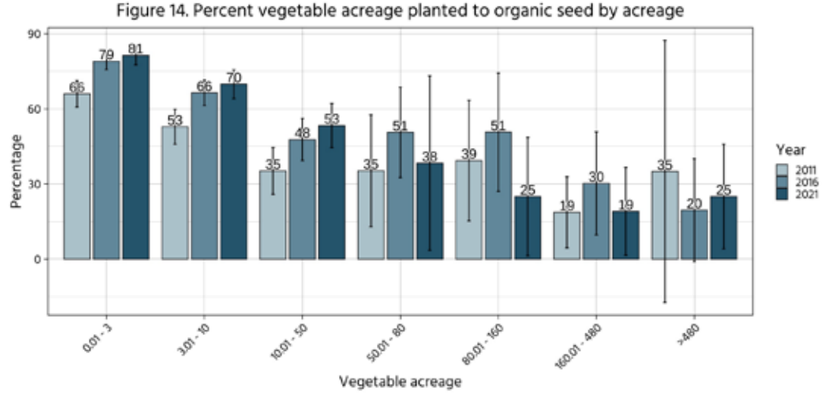


Figure 15. Map of percent vegetable acreage planted to organic seed in 2021

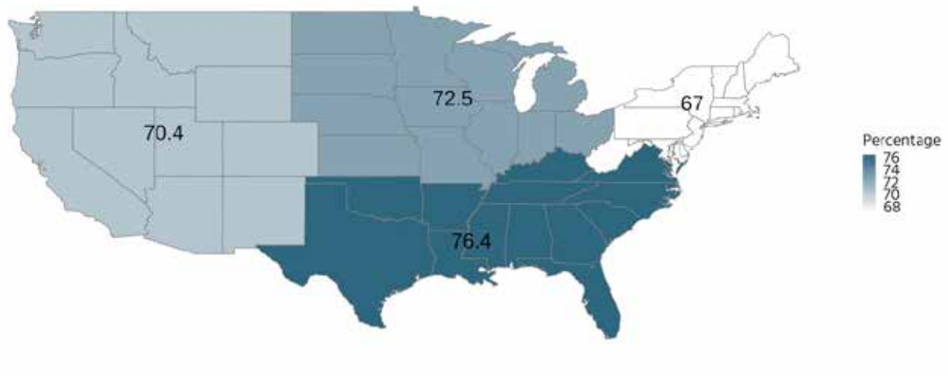


Figure 16. Map of percent vegetable acreage planted to organic seed in 2016

Figure 17. Map of percent vegetable acreage planted to organic seed in 2011

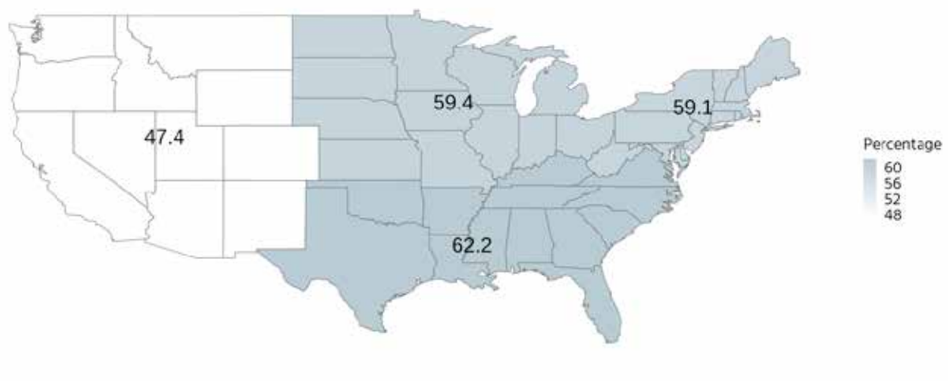


Figure 18. Percent cover crop acreage planted to organic seed

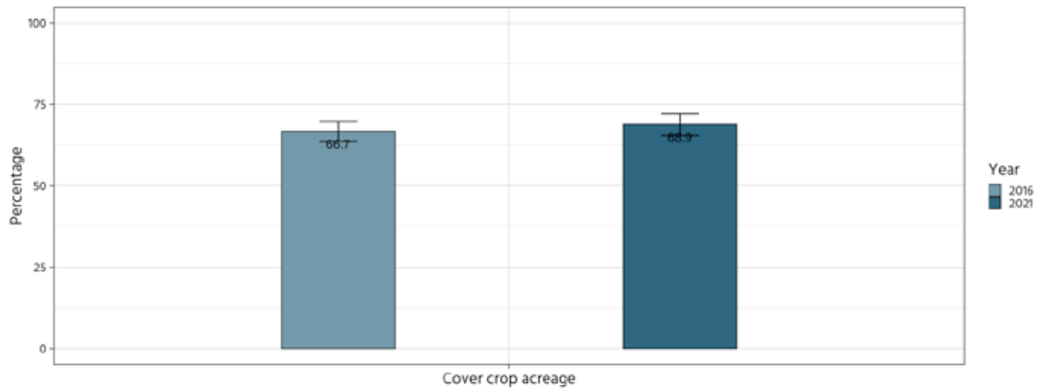


Figure 19. Percent cover crop acreage planted to organic seed

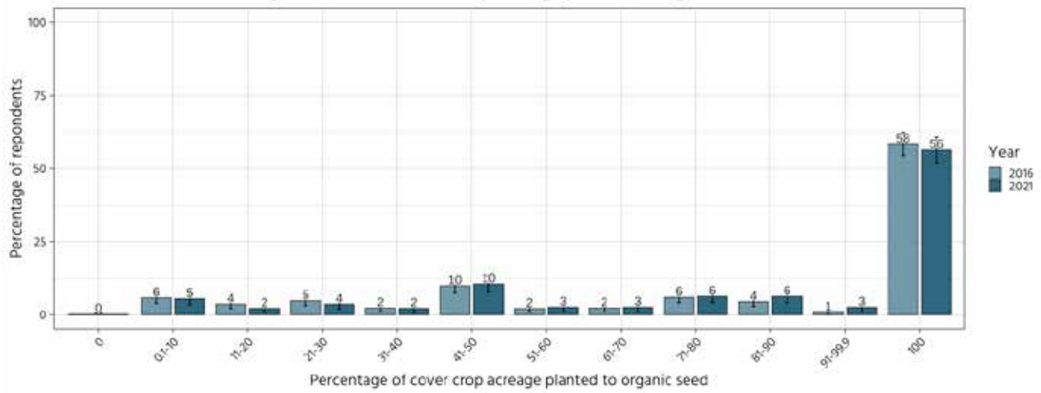


Figure 20. Percent cover crop acreage planted to organic seed by acreage

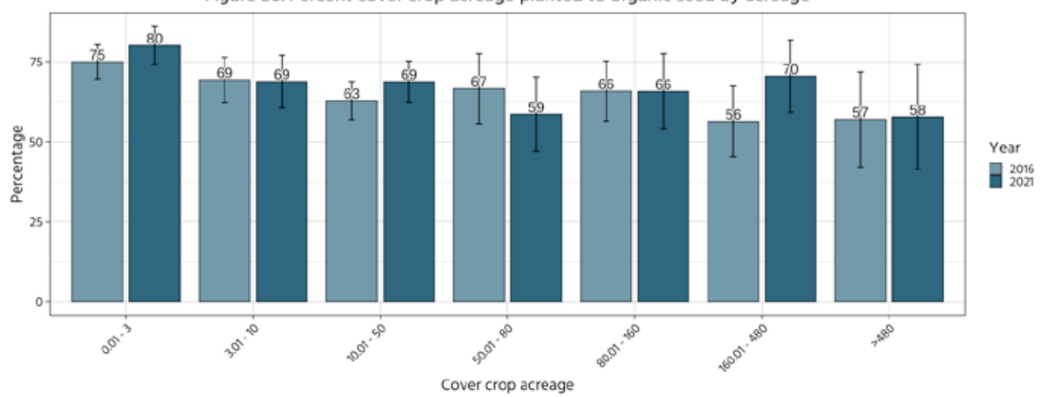


Figure 21. Map of percent cover crop acreage planted to organic seed in 2021

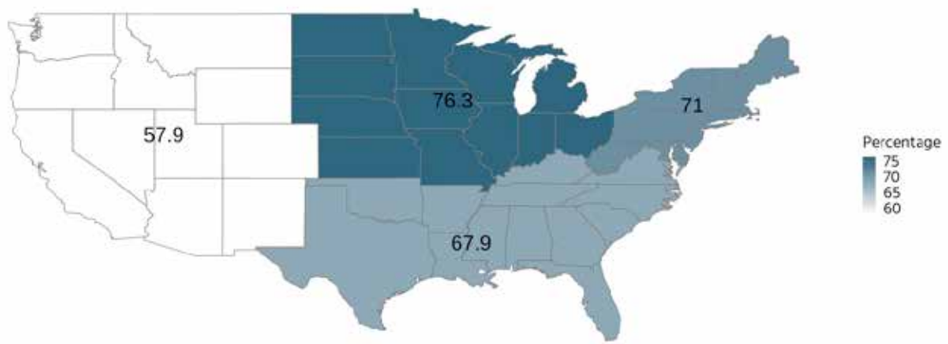


Figure 22. Map of percent cover crop acreage planted to organic seed in 2016

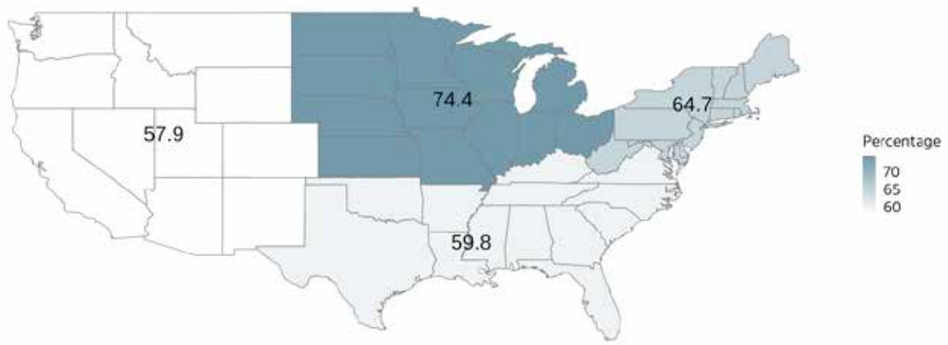


Figure 23. Map of percent cover crop acreage planted to organic seed in 2011

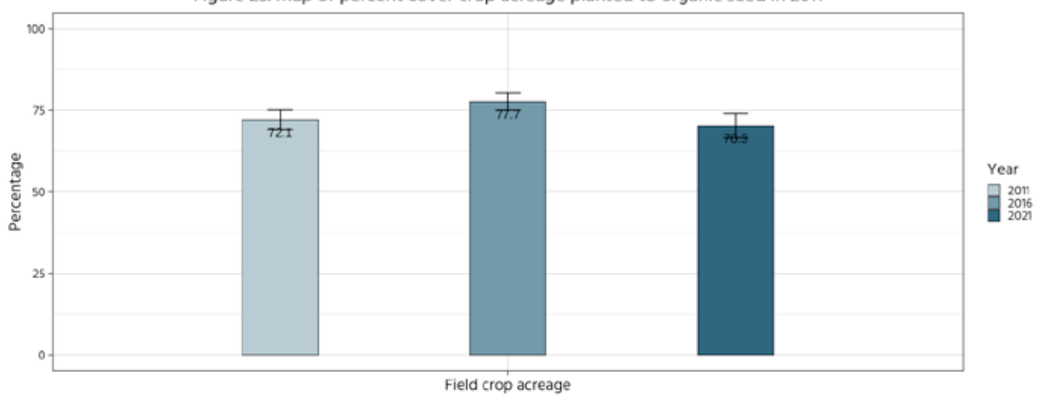


Figure 24. Percent field crop acreage planted to organic seed

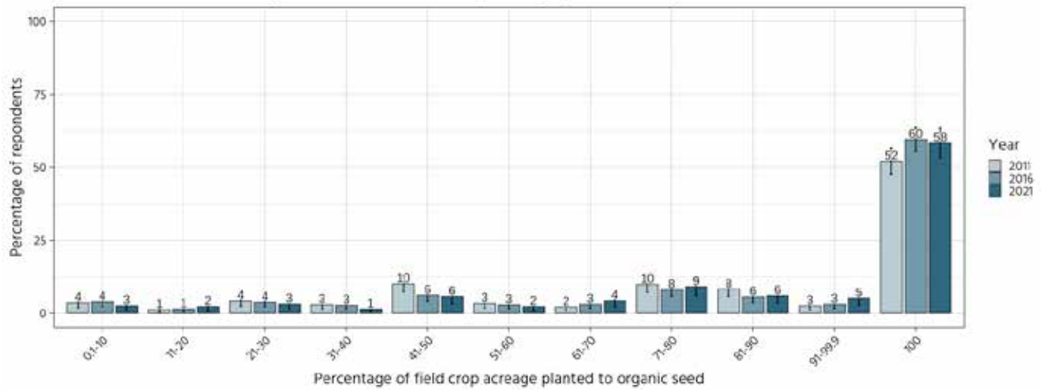


Figure 25. Percent field crop acreage planted to organic seed by acreage

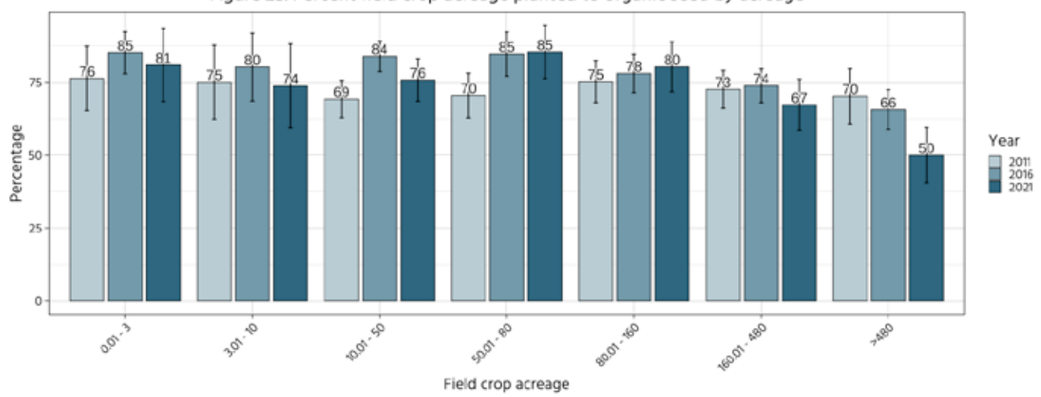


Figure 26. Map of percent field crop acreage planted to organic seed in 2021

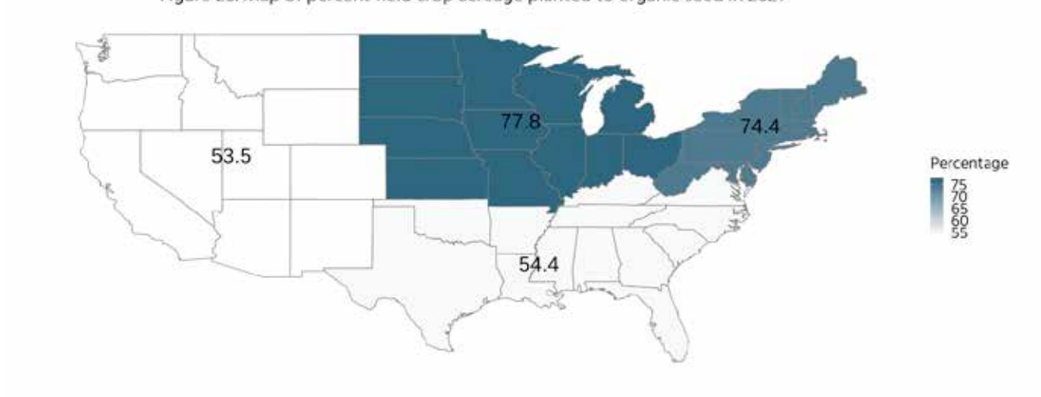


Figure 27. Map of percent field crop acreage planted to organic seed in 2016

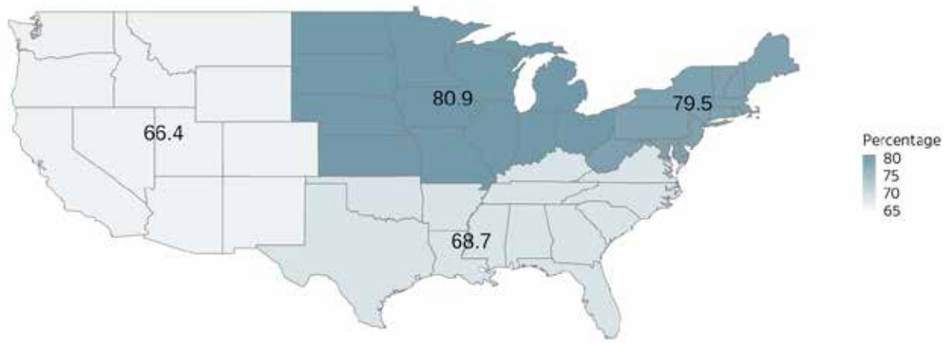


Figure 28. Map of percent field crop acreage planted to organic seed in 2011

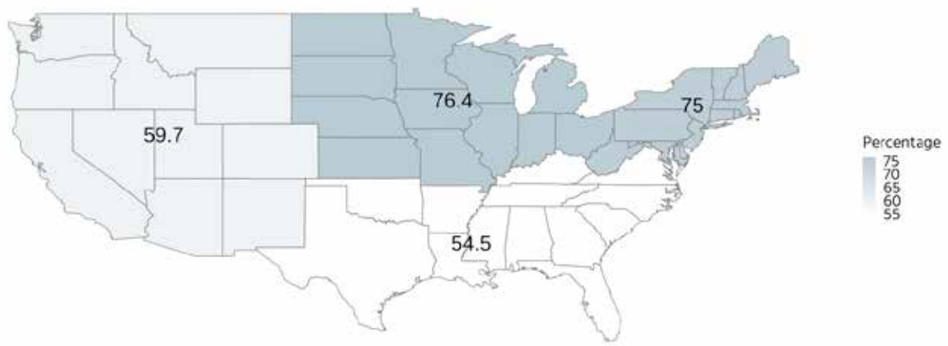


Figure 29. Percent forage crop acreage planted to organic seed

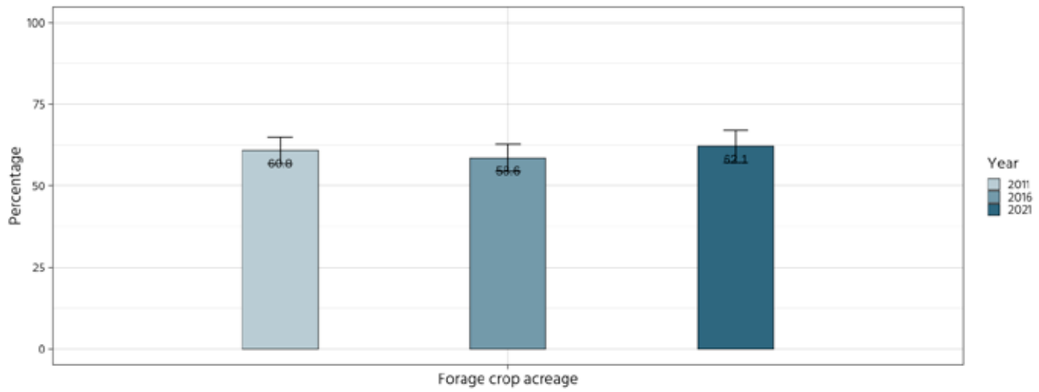


Figure 30. Percent forage crop acreage planted to organic seed

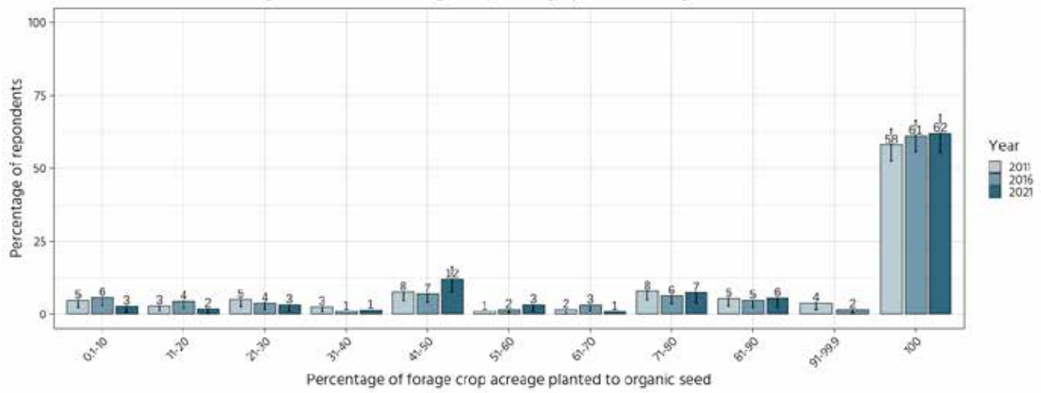


Figure 31. Percent forage crop acreage planted to organic seed by acreage

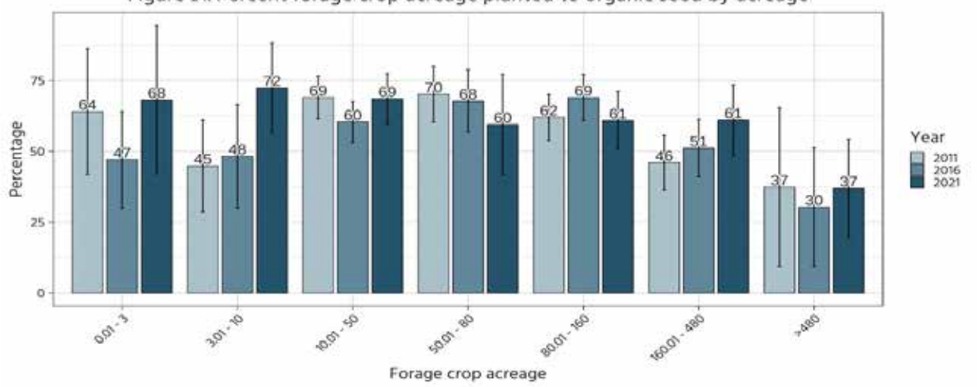


Figure 32. Map of percent forage crop acreage planted to organic seed in 2021

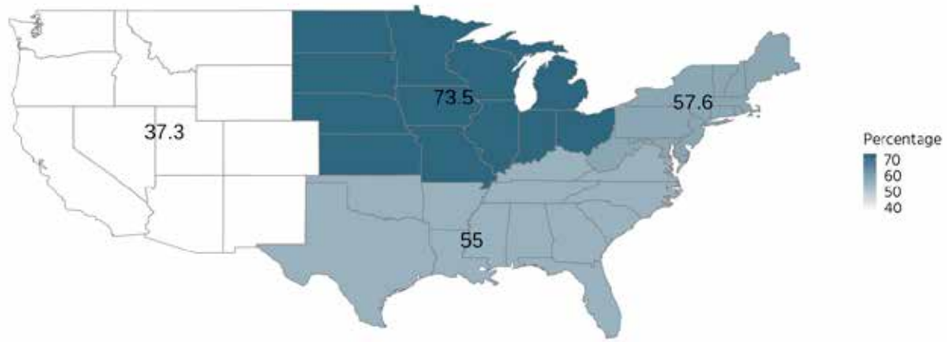


Figure 33. Map of percent forage crop acreage planted to organic seed in 2016

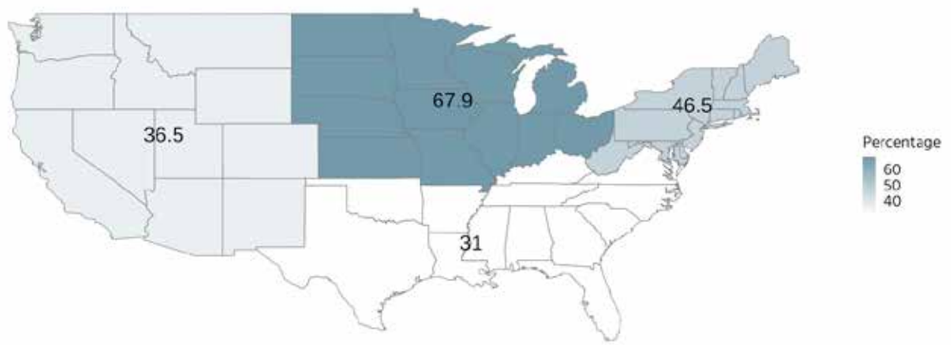


Figure 34. Map of percent forage crop acreage planted to organic seed in 2011

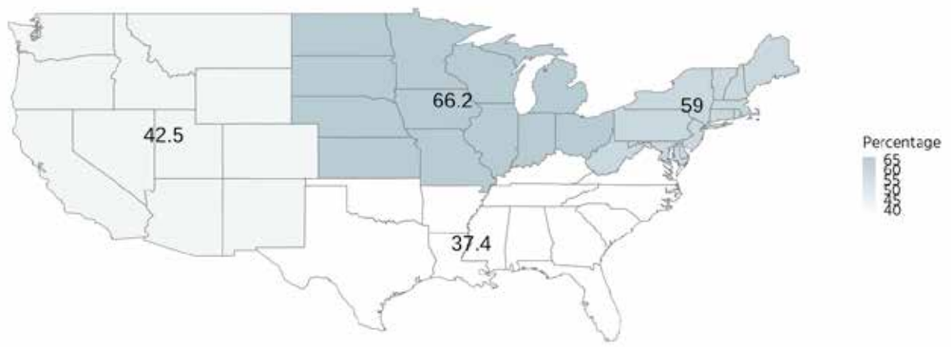


Figure 35. Percentage of producers using only organic seed

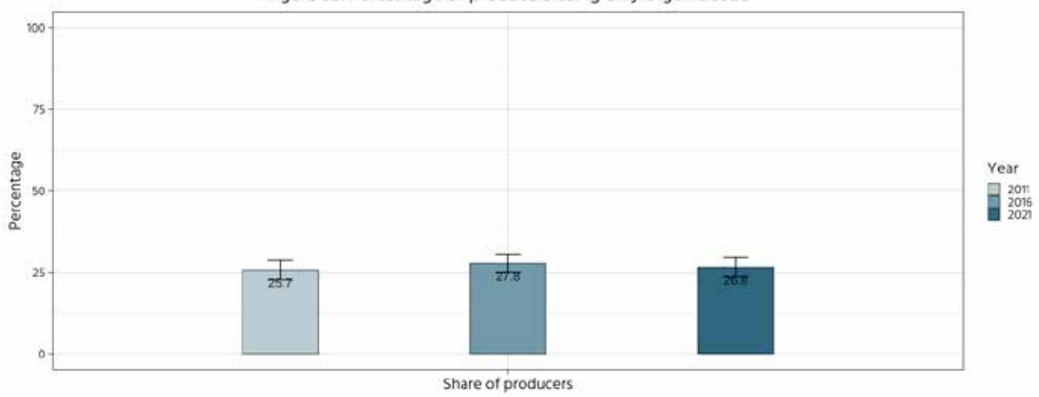


Figure 36. Percentage of producers using only organic seed by acreage

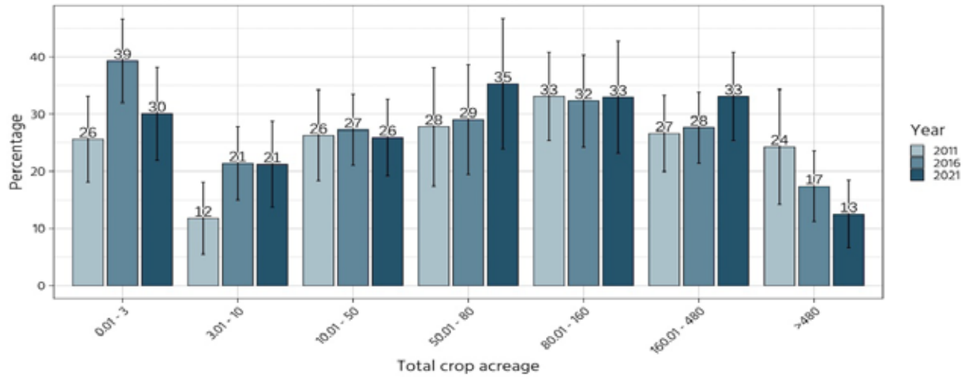


Figure 37. Regional map of percentage of 2021 producers using only organic seed

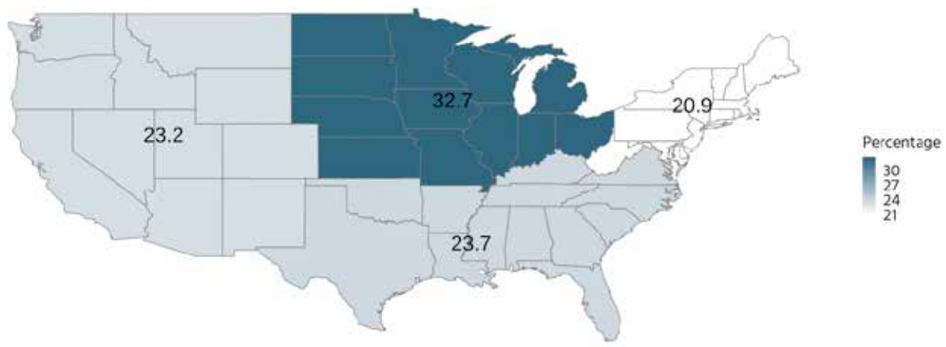


Figure 38. Regional map of percentage of 2016 producers using only organic seed

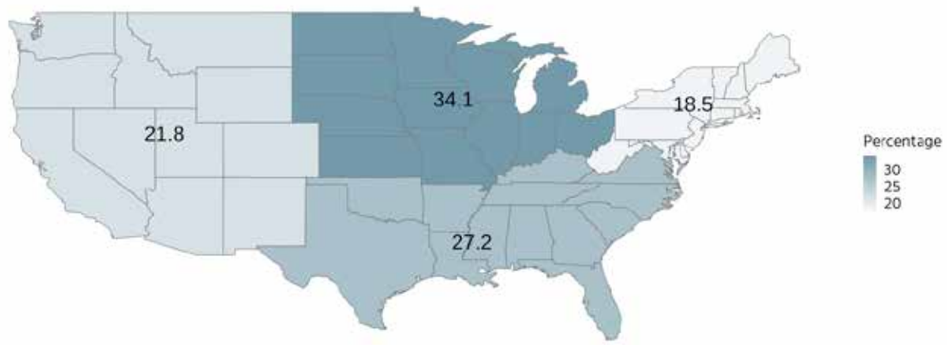


Figure 39. Regional map of percentage of 2011 producers using only organic seed

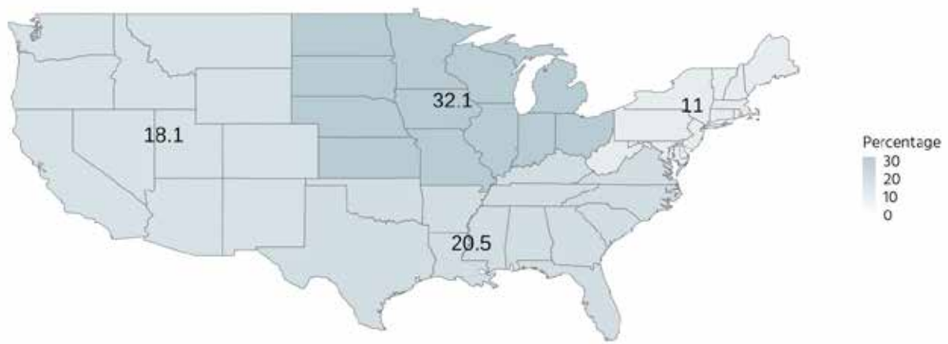


Figure 40. Over the last 3 years, have you decreased or increased the percentage of organic seed that you use in vegetable crops

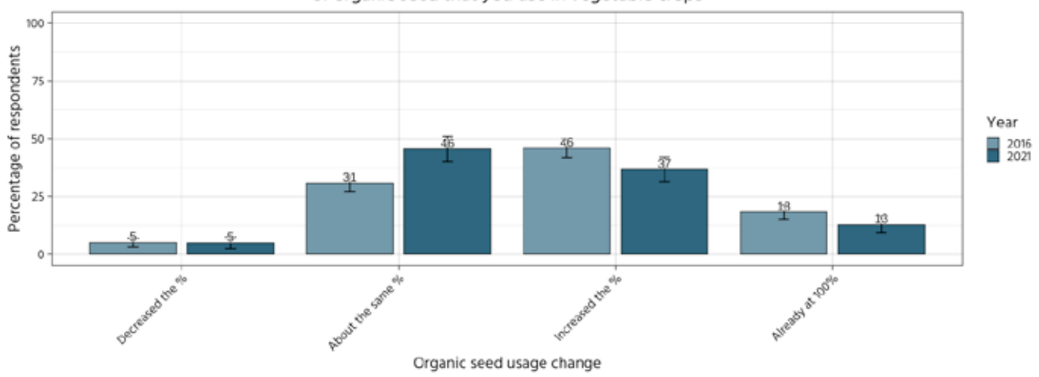


Figure 41. Over the last 3 years, have you decreased or increased the percentage of organic seed that you use in field crops

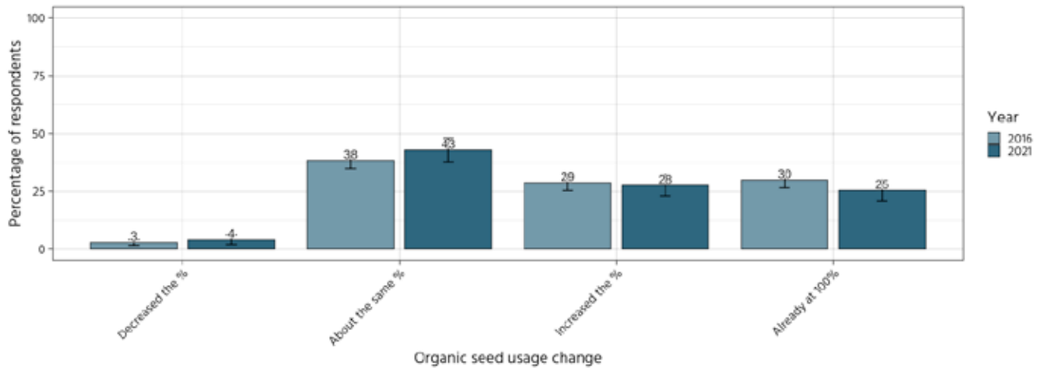


Figure 42. Over the last 3 years, have you decreased or increased the percentage of organic seed that you use in cover crops

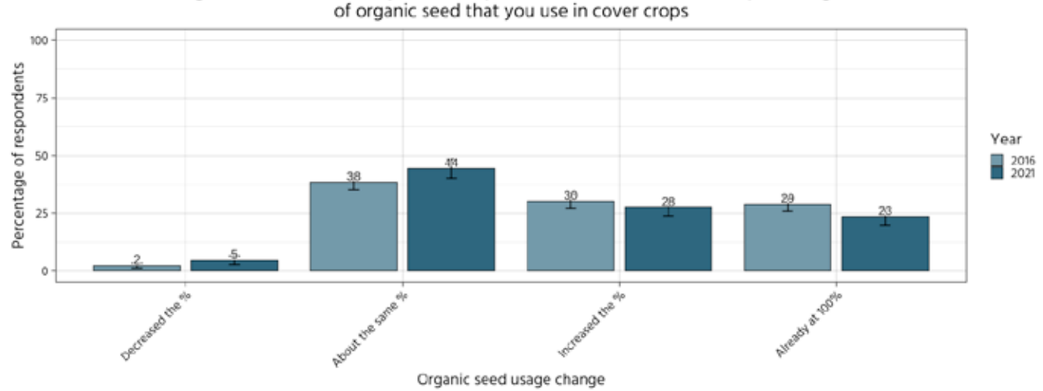


Figure 43. Over the last 3 years, have you decreased or increased the percentage of organic seed that you use in forage crops

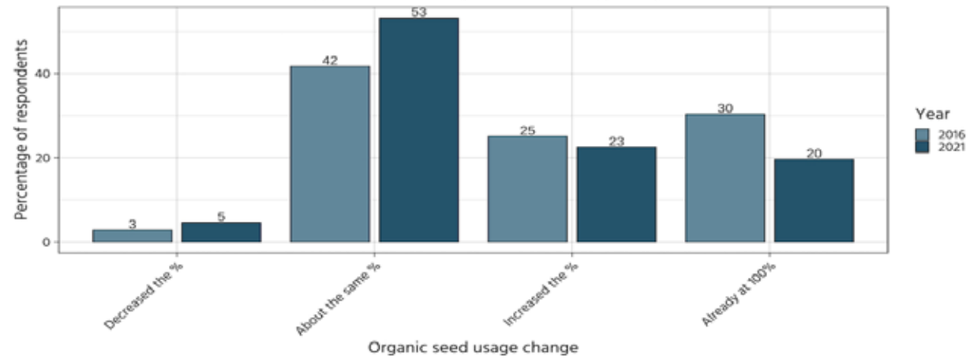


Figure 44. Average percentage of seed used that was sourced from own production

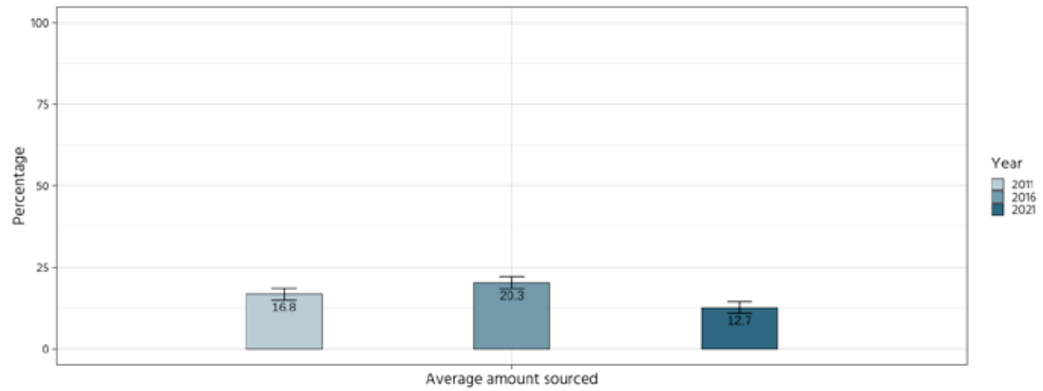


Figure 45. Average percentage of seed used that was sourced from processor or buyer

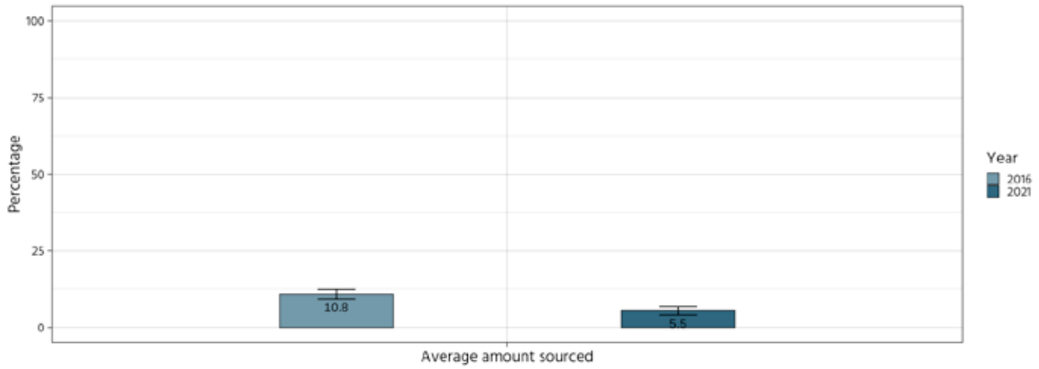


Figure 46. Average percentage of seed used that was sourced directly from seed company (via catalog, sales rep, etc)

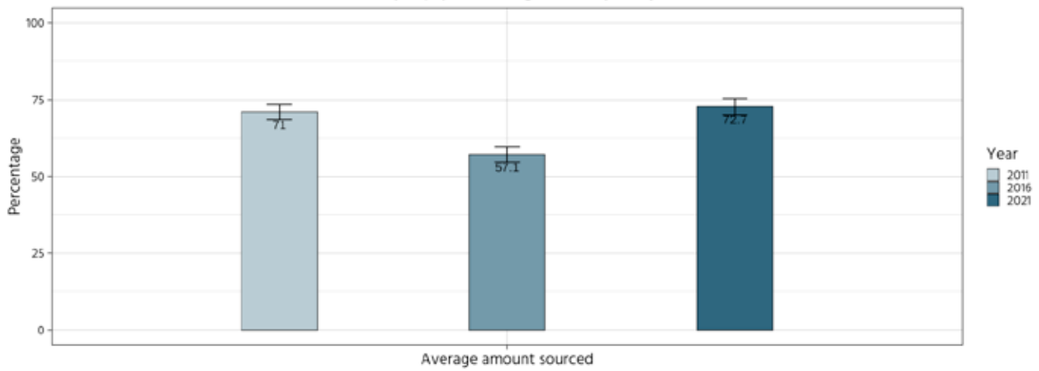


Figure 47. Average percentage of seed used that was sourced from farm or garden store

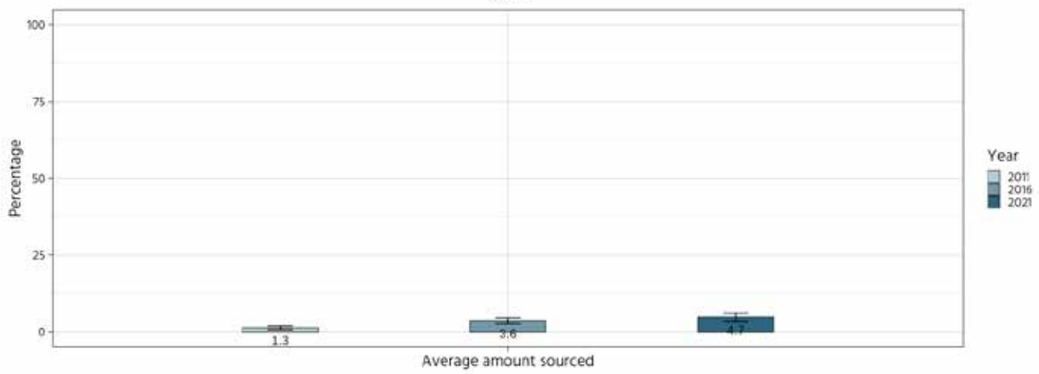


Figure 48. Average percentage of seed used that was sourced from other farmers

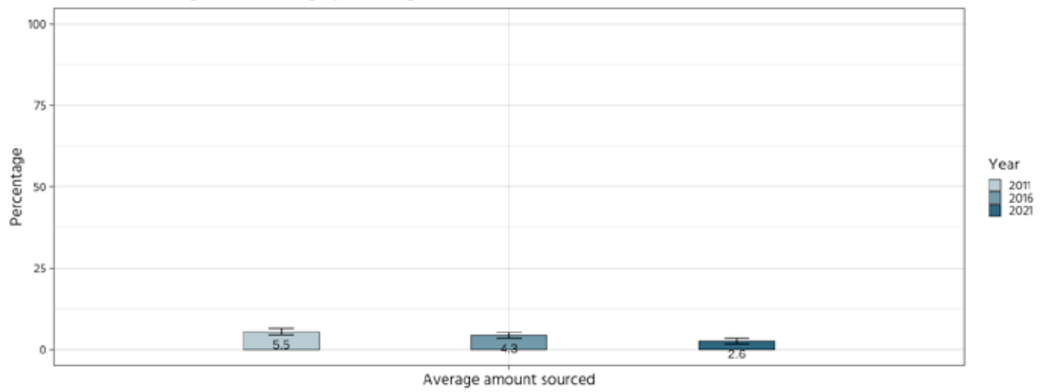


Figure 49. Over the last 3 years, has your certifier requested that you take greater steps to source organic seed?

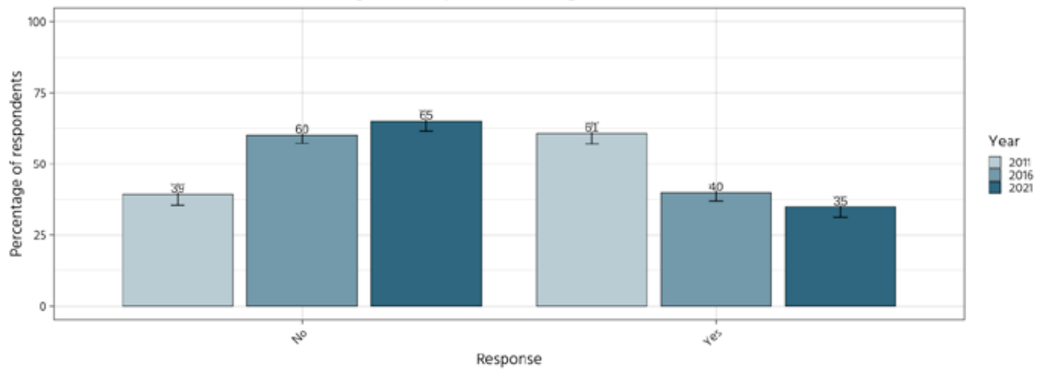


Figure 50. If your certifier requested additional steps to source organic seed, did they ask that you conduct trials of available organic varieties?

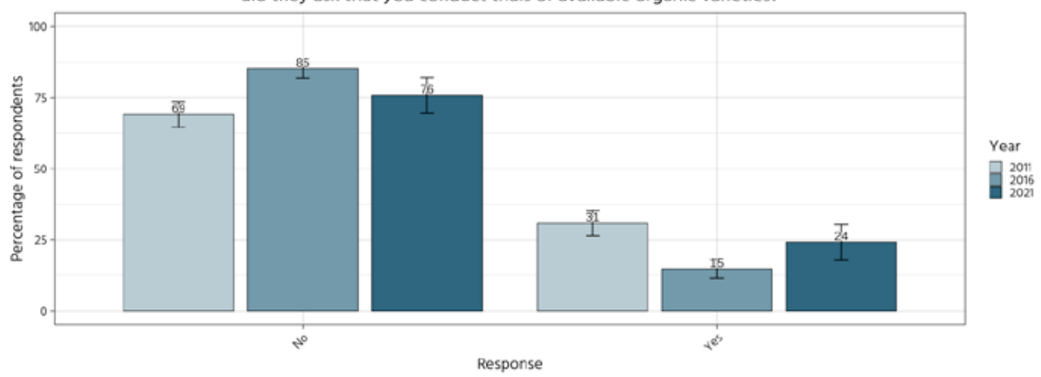


Figure 51. If your certifier requested additional steps to source organic seed, did they ask that you search organic seed finder or another online database?

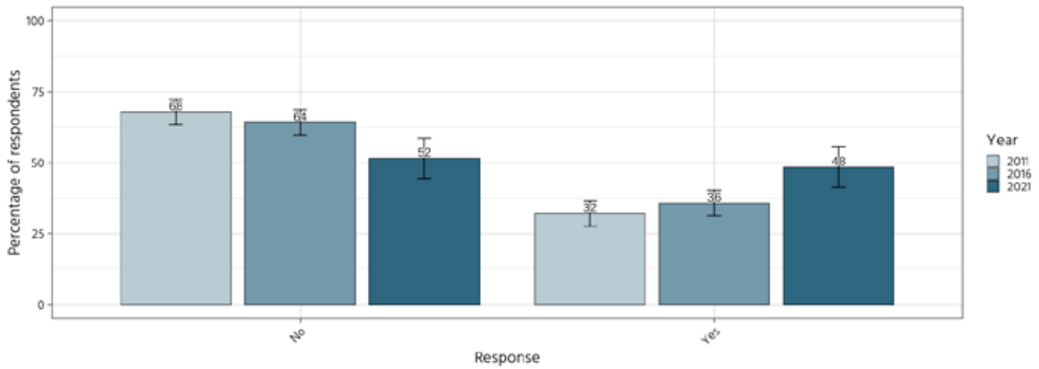


Figure 52. If your certifier requested additional steps to source organic seed, did they ask that you research more than 3 seed catalogs?

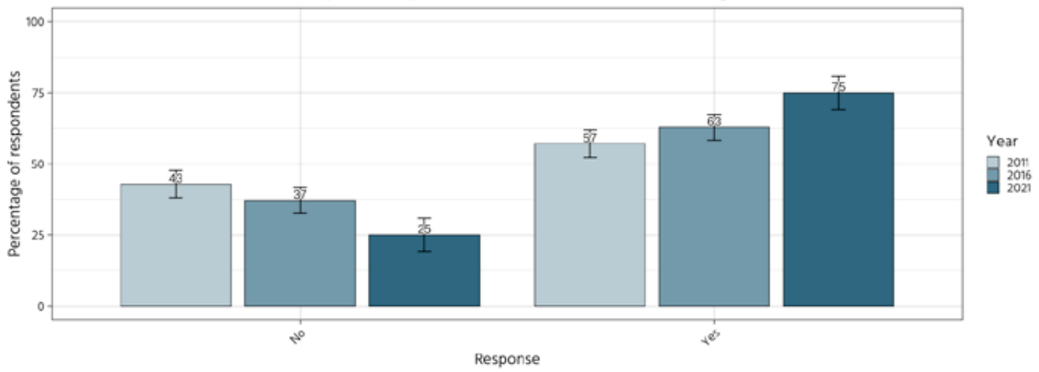


Figure 53. If your certifier requested additional steps to source organic seed, did they ask that you request seed in a timely manner?

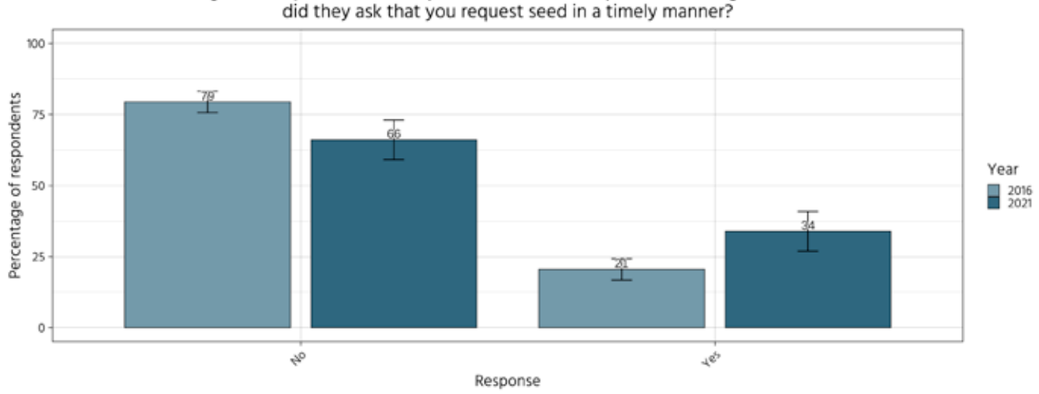


Figure 54. If your certifier requested additional steps to source organic seed, did they ask that you contract organic seed production?

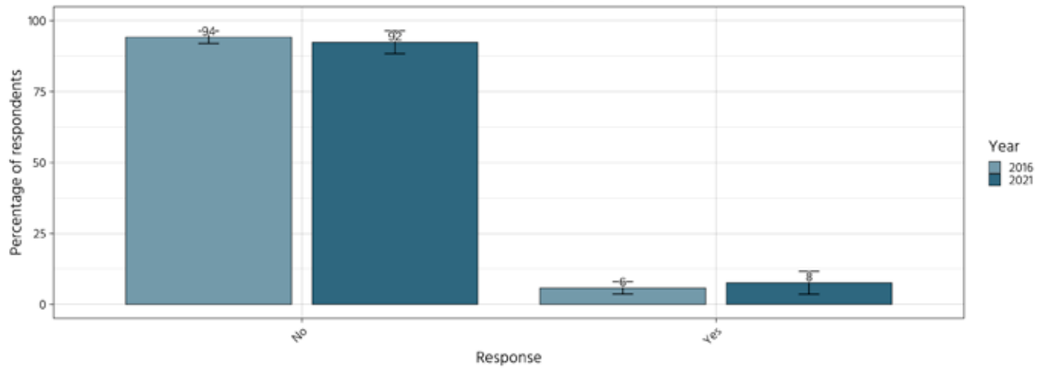


Figure 55. Percentage of producers growing their own seed

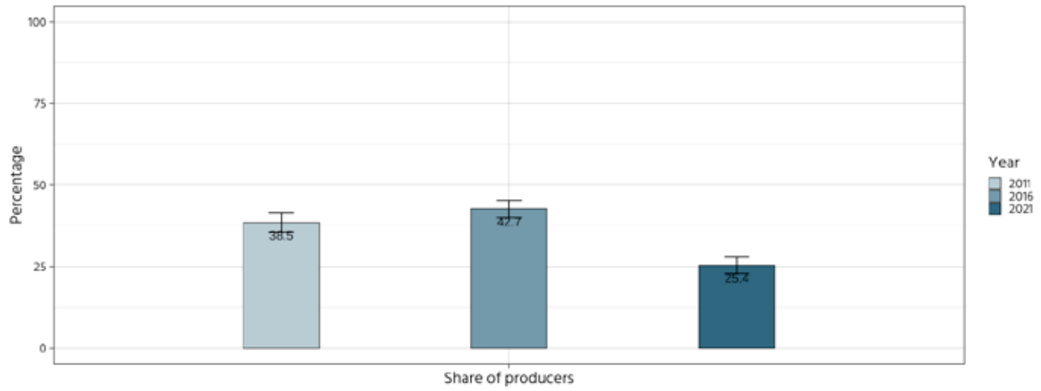


Figure 56. Regional map of percentage of 2021 producers growing their own seed

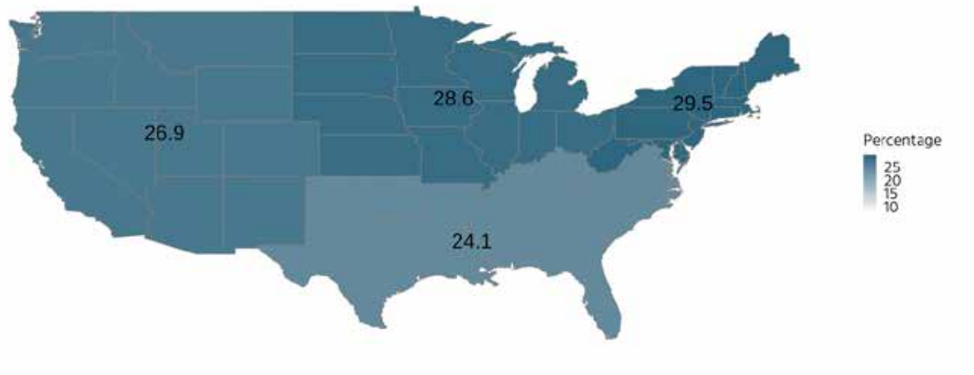


Figure 57. Regional map of percentage of 2016 producers growing their own seed

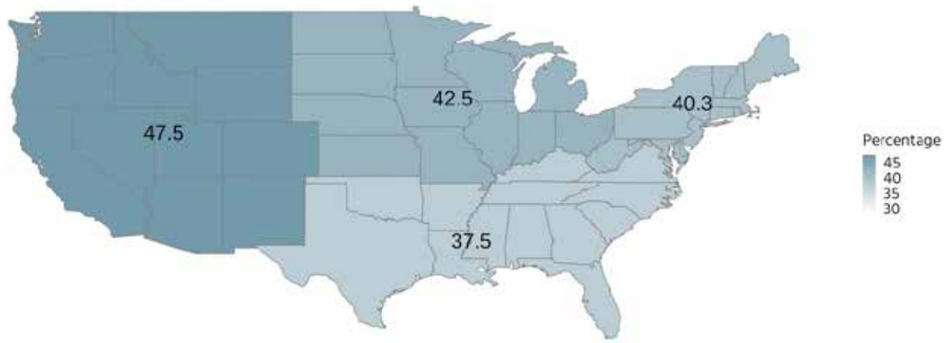


Figure 58. Regional map of percentage of 2011 producers growing their own seed

Figure 59. Which of the following categories best fit your situation pertaining to producing organic seed?

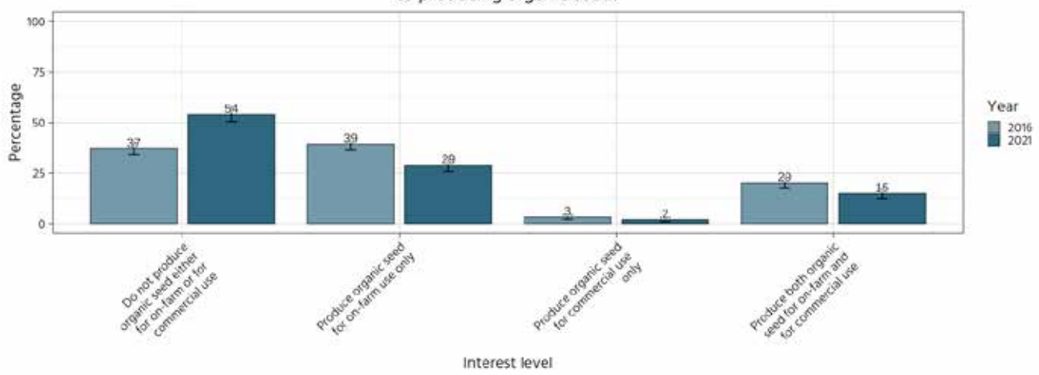


Figure 60. Are you interested in producing organic seed for commercial use at some point in the future?

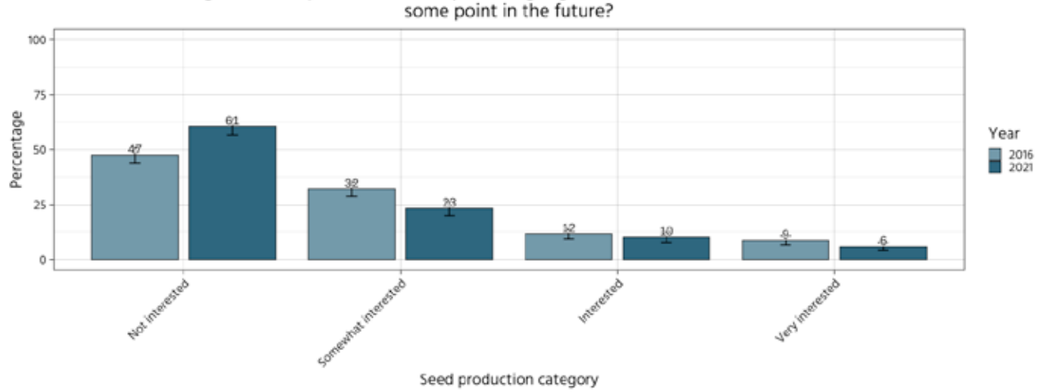


Figure 61. Regional map of percentage of 2021 producers interested in growing seed

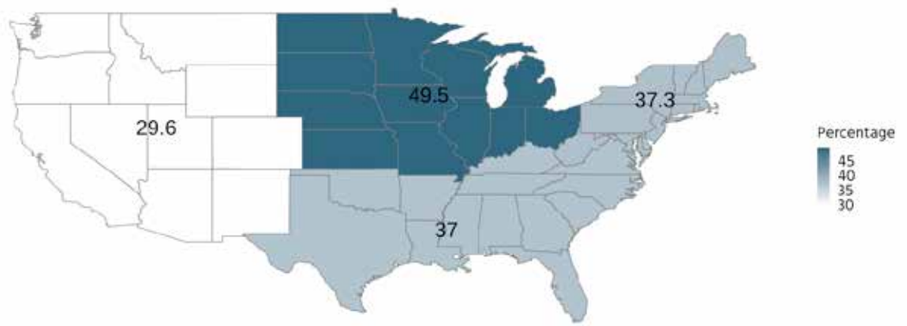


Figure 62. How much was lack of seed treatments (such as pelleting or priming) a factor in your decision not to purchase organic seed?

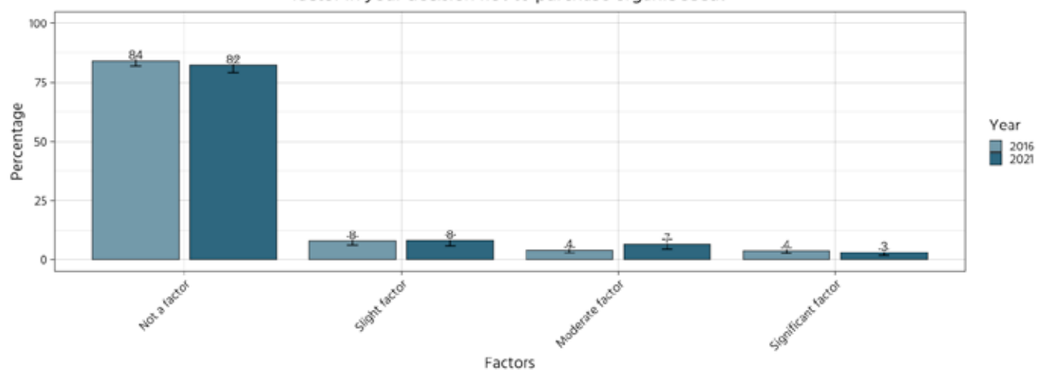


Figure 63. Lack of seed treatments a moderate or significant factor by vegetable acreage

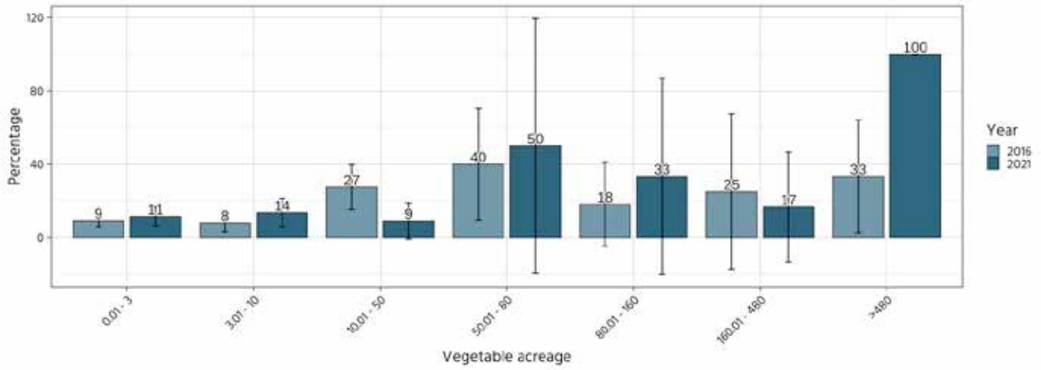


Figure 64. Lack of seed treatments a moderate or significant factor by field crop acreage

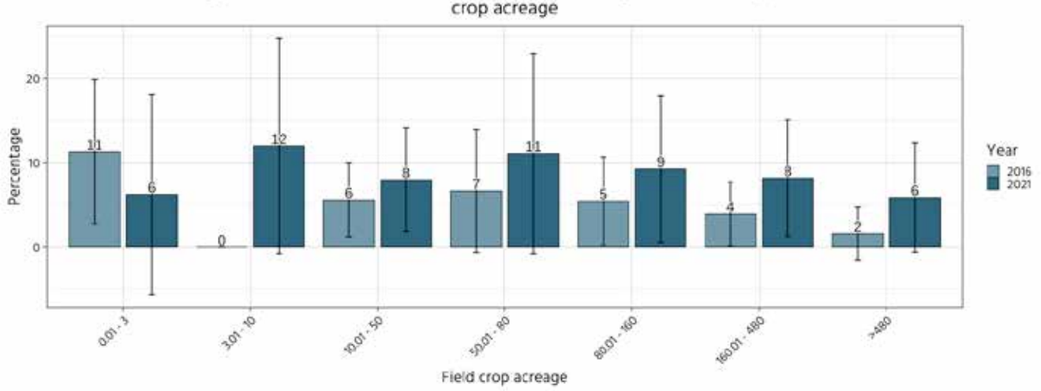


Figure 65. Lack of seed treatments a moderate or significant factor by forage crop acreage

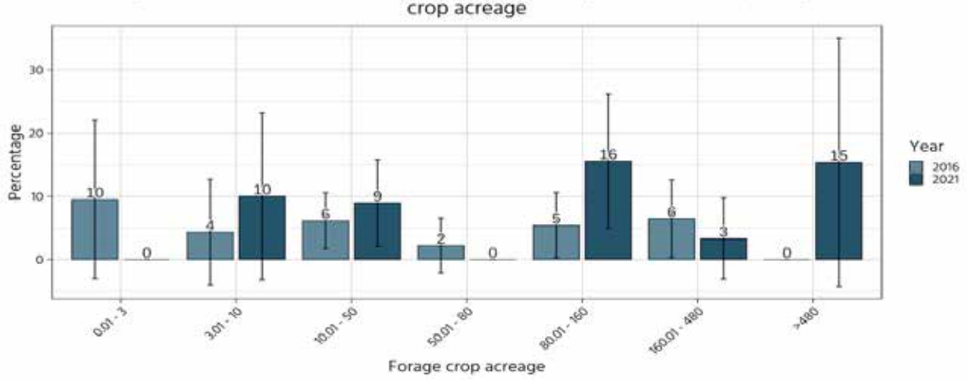


Figure 66. How much was processor (buyer) requiring or supplying varieties that are not available organically a factor in your decision not to purchase organic seed?

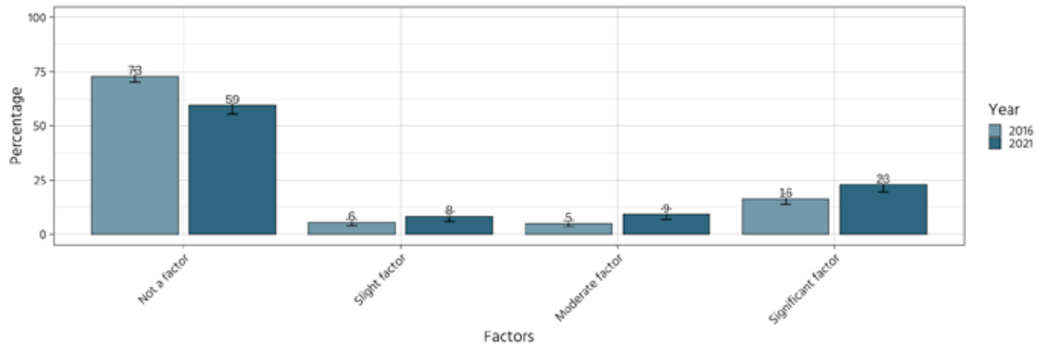


Figure 67. Buyer requires variety not available as organic by vegetable acreage

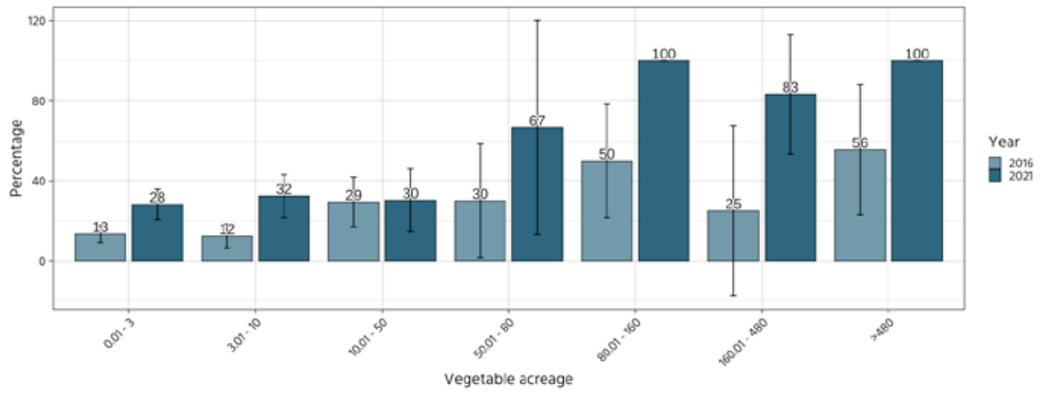


Figure 68. Buyer requires variety not available as organic by field crop acreage

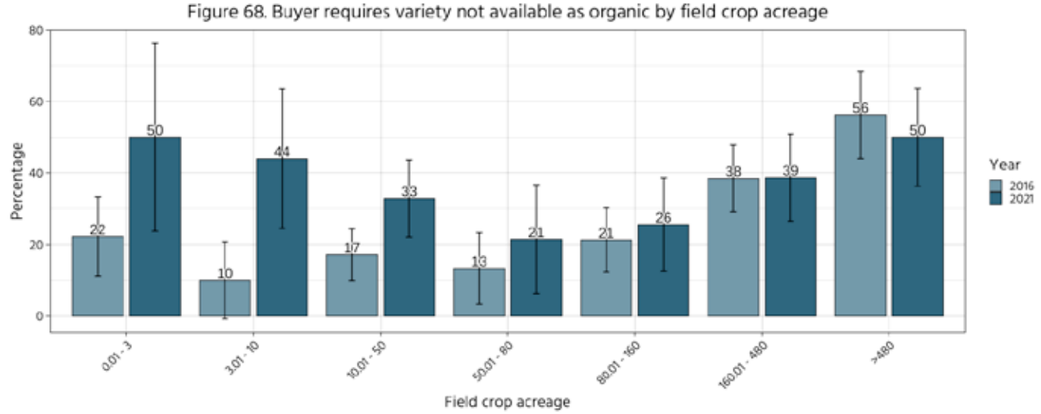


Figure 69. Buyer requires variety not available as organic by forage crop acreage

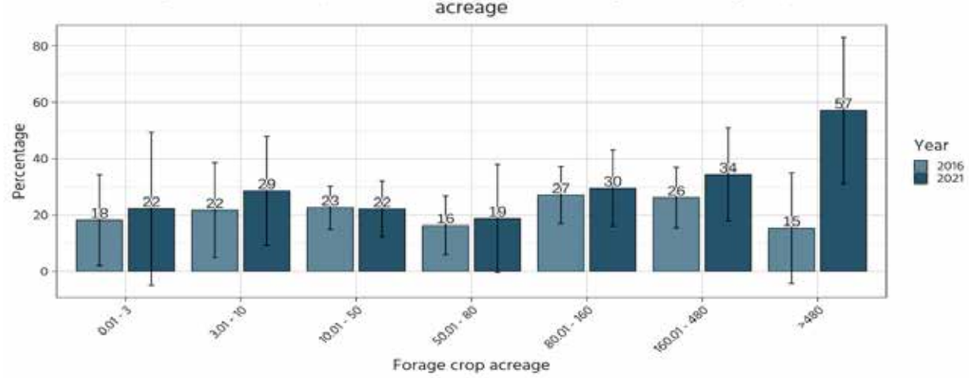


Figure 70. How much was an insufficient quantity of seed a factor in your decision not to purchase organic seed?

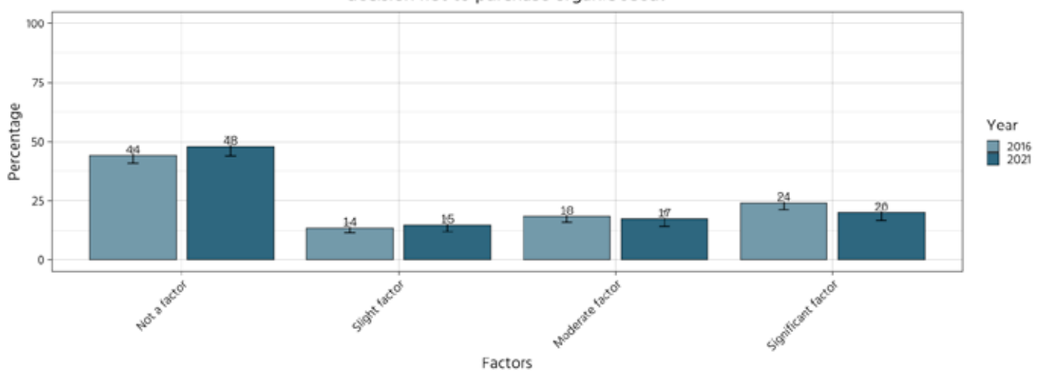


Figure 71. Insufficient quantity of seed by vegetable acreage

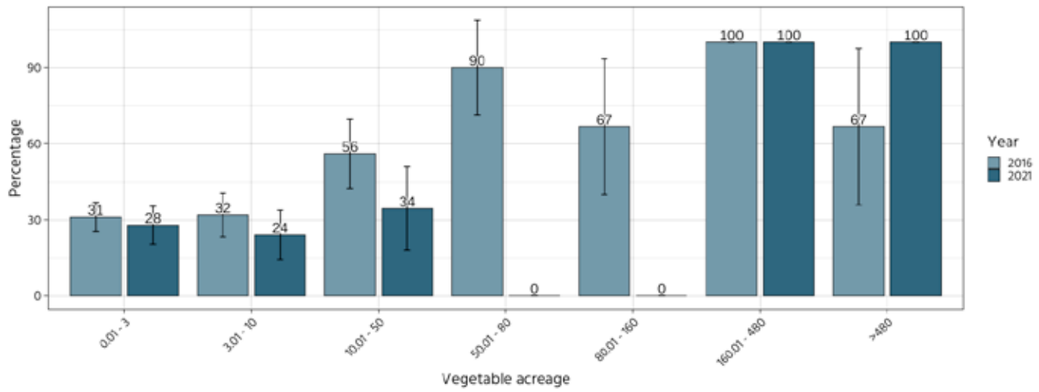


Figure 72. Insufficient quantity of seed by field crop acreage

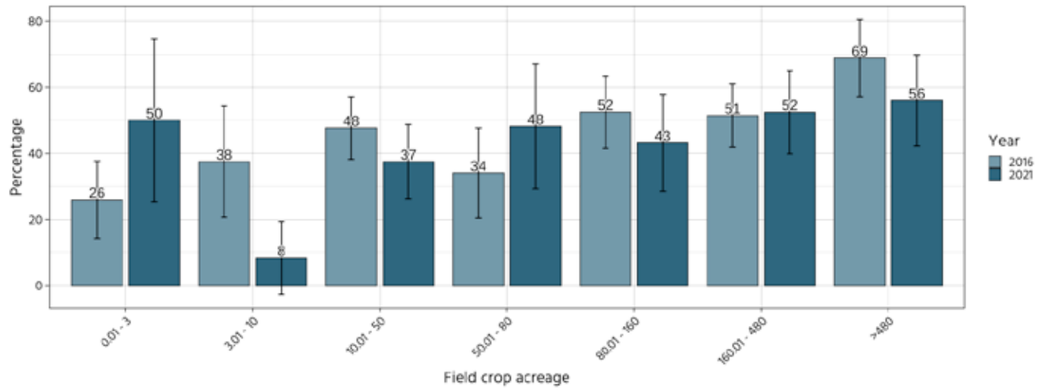


Figure 73. Insufficient quantity of seed by forage crop acreage

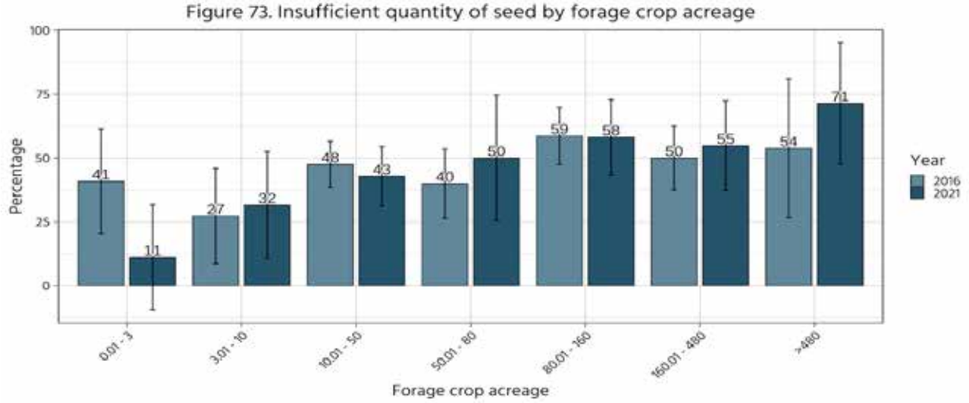


Figure 74. How much was saving your own seed a factor in your decision not to purchase organic seed?

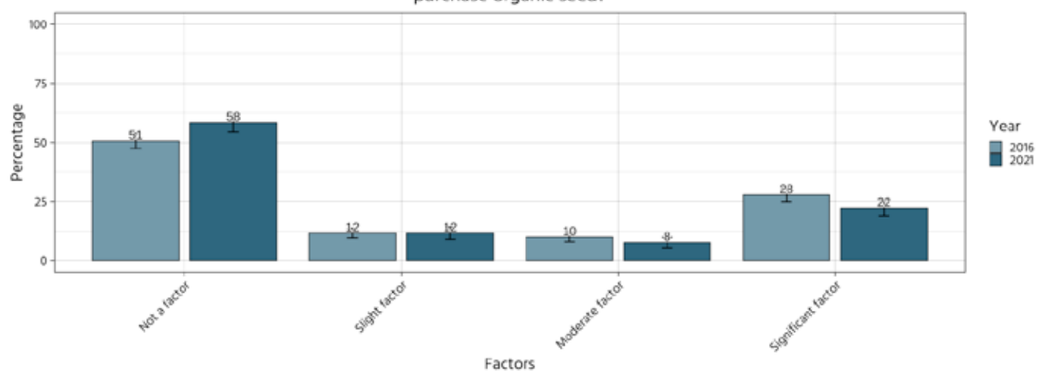


Figure 75. Seed saving a factor in not purchasing organic seed by vegetable acreage

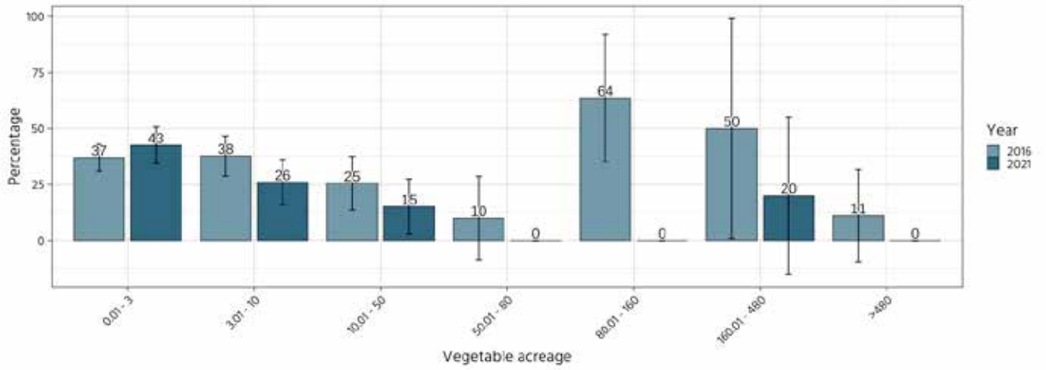


Figure 76. Seed saving a factor in not purchasing organic seed by field crop acreage

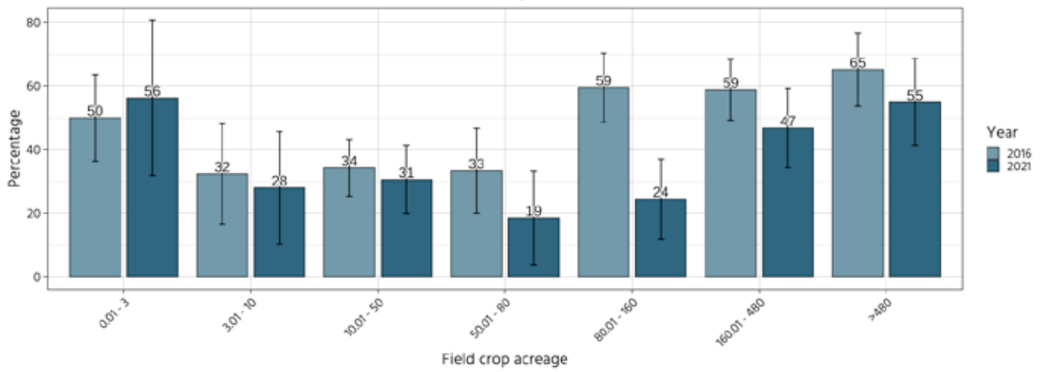


Figure 77. Seed saving a factor in not purchasing organic seed by forage crop acreage

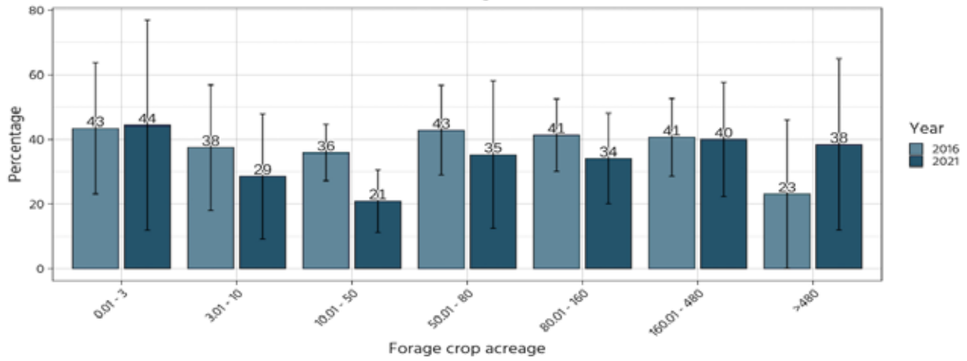


Figure 78. How much was distrust of organic seed quality a factor in your decision not to purchase organic seed?

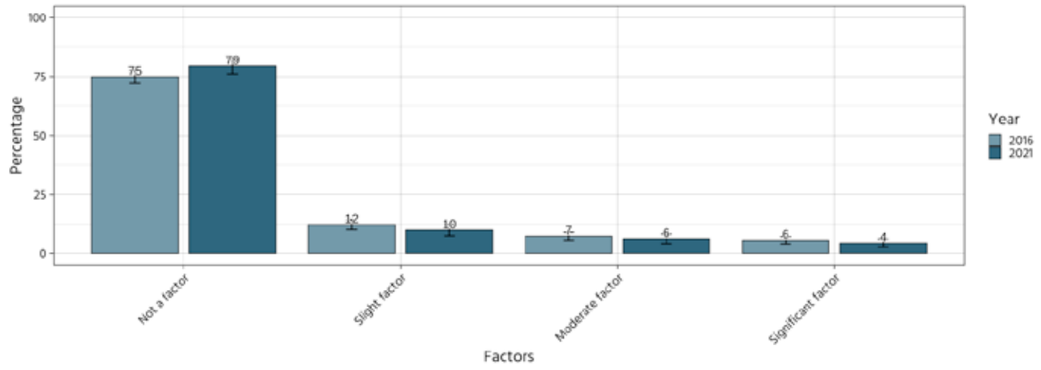


Figure 79. Distrust of organic seed quality a factor in not purchasing organic seed by vegetable acreage

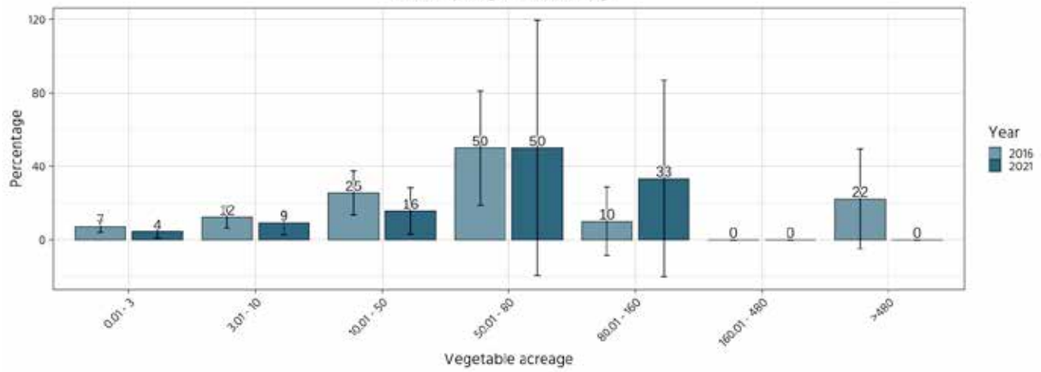


Figure 80. Distrust of organic seed quality a factor in not purchasing organic seed by field crop acreage

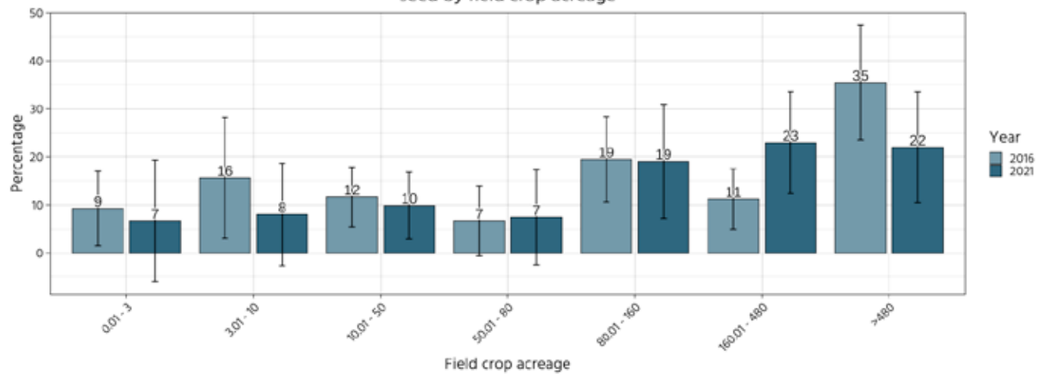


Figure 81. Distrust of organic seed quality a factor in not purchasing organic seed by forage crop acreage

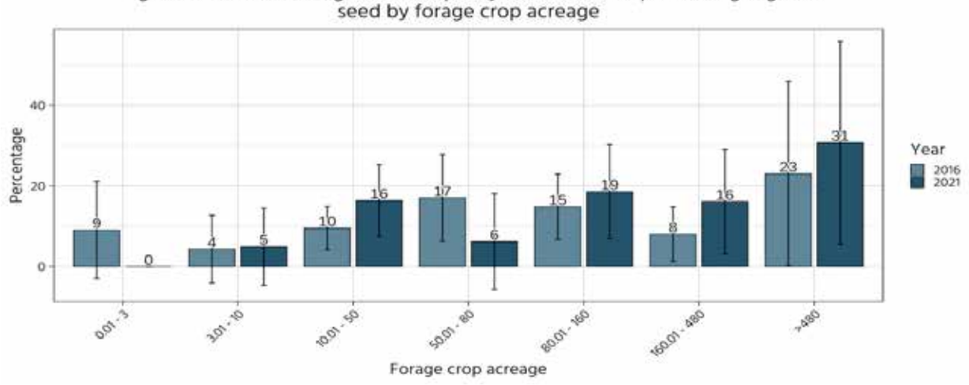


Figure 82. How much was price a factor in your decision not to purchase organic seed?

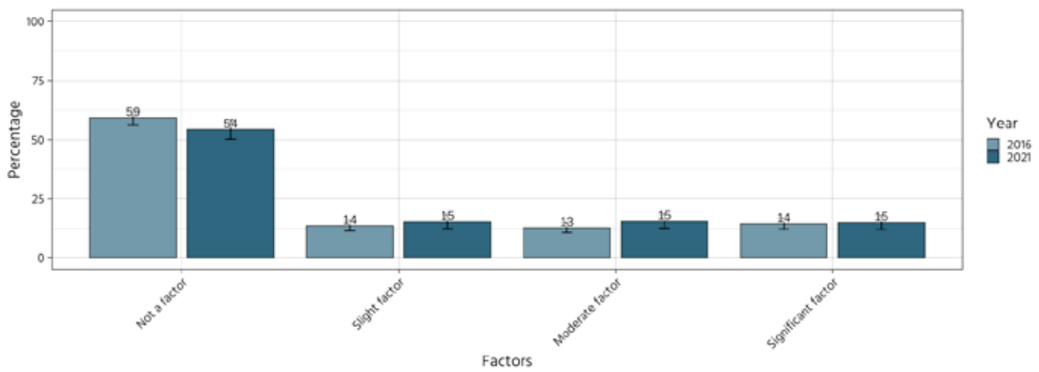


Figure 83. Price a factor in not purchasing organic seed by vegetable acreage

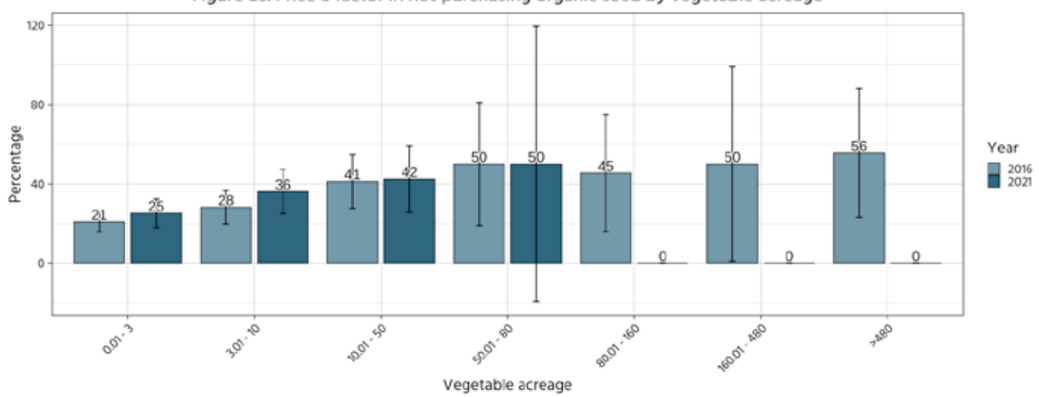


Figure 84. Price a factor in not purchasing organic seed by field crop acreage

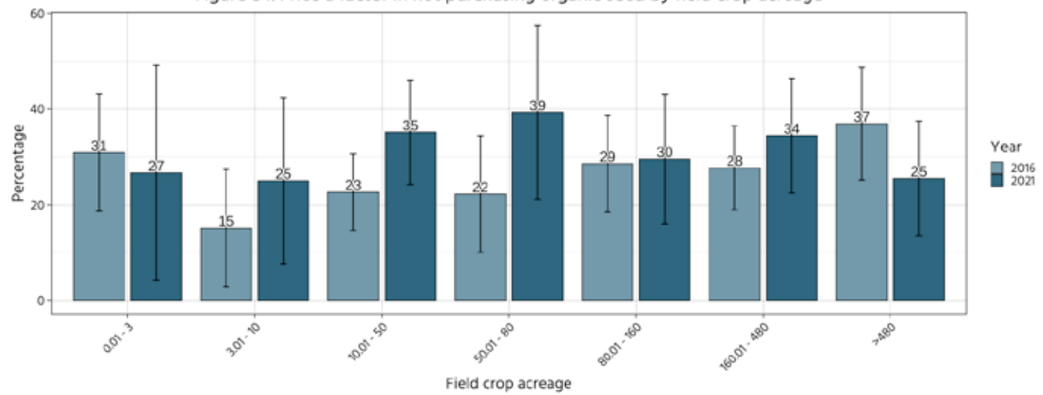


Figure 85. Price a factor in not purchasing organic seed by forage crop acreage

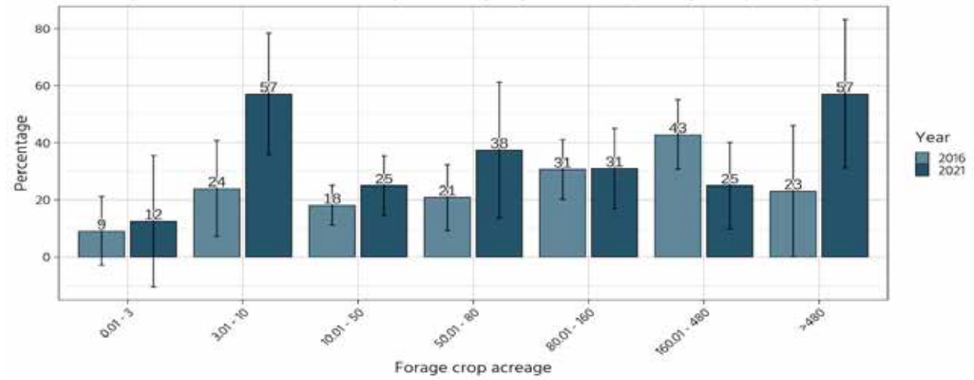


Figure 86. How much was the inavailability of specific varieties in organic seed a factor in your decision not to purchase organic seed?

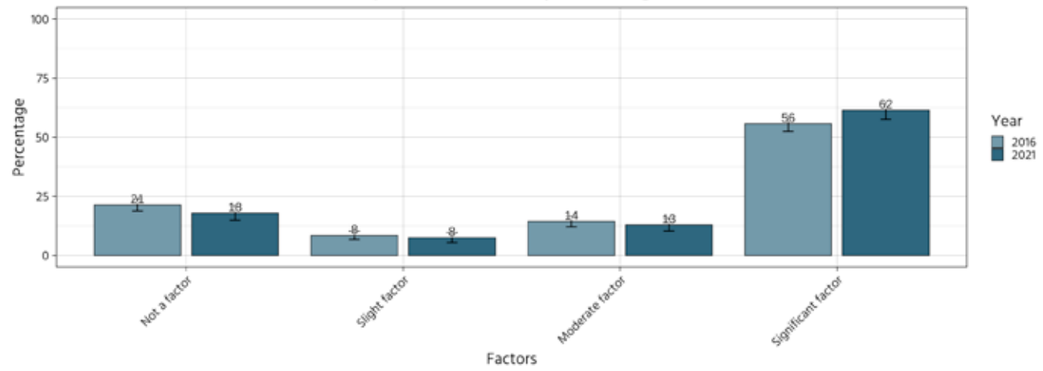


Figure 87. Variety not available as organic seed a factor in not purchasing organic seed by vegetable acreage

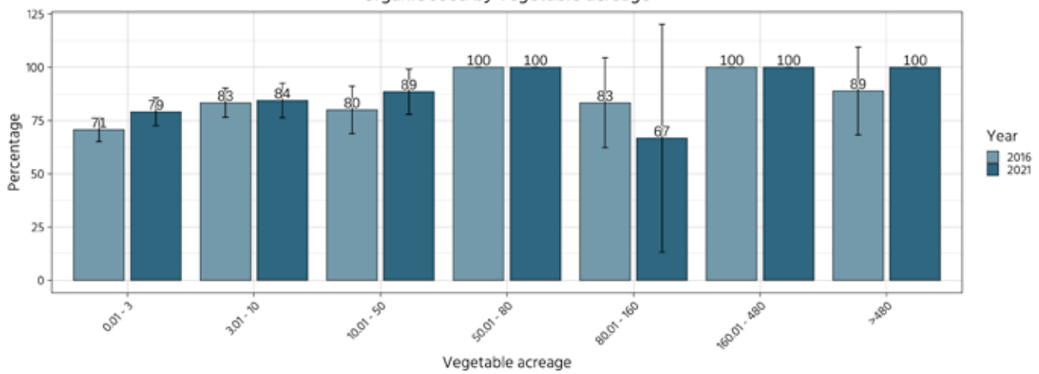


Figure 88. Variety not available as organic seed a factor in not purchasing organic seed by field crop acreage

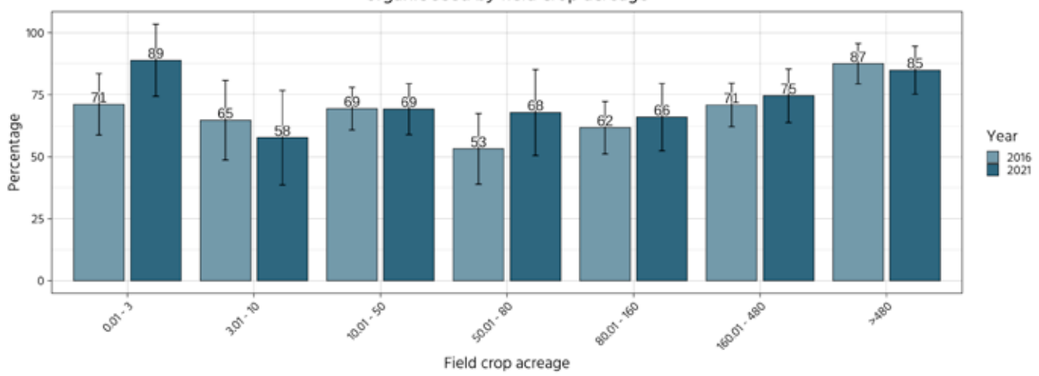


Figure 89. Variety not available as organic seed a factor in not purchasing organic seed by forage crop acreage

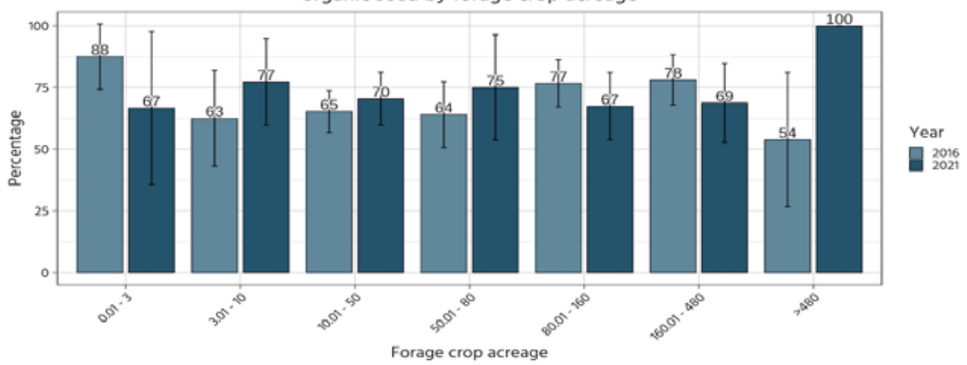


Figure 90. How much was the lack of desirable genetic traits a factor in your decision not to purchase organic seed?

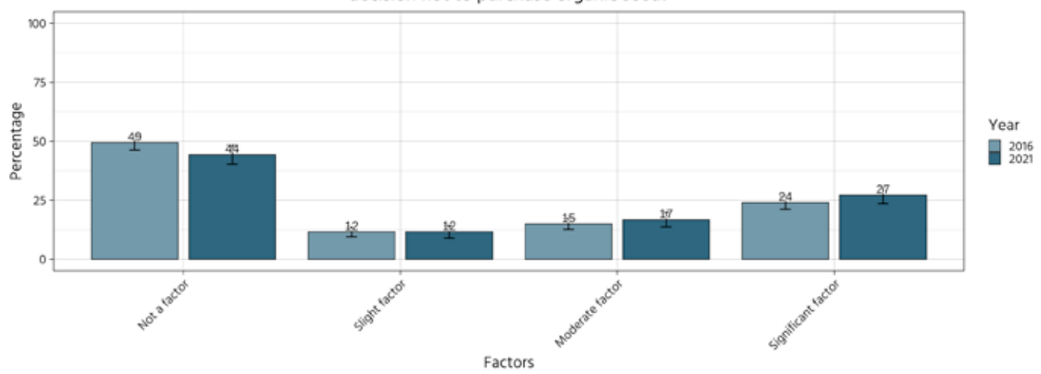


Figure 91. Lack of desirable genetic traits a factor in not purchasing organic seed by vegetable acreage

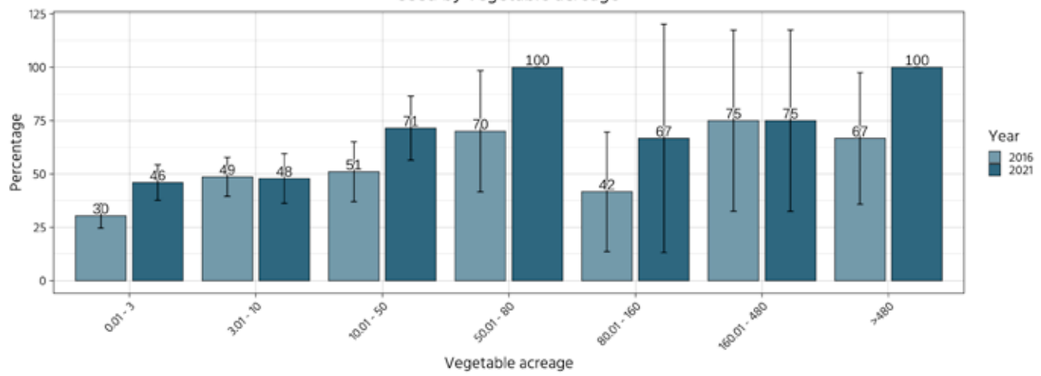


Figure 92. Lack of desirable genetic traits a factor in not purchasing organic seed by field crop acreage

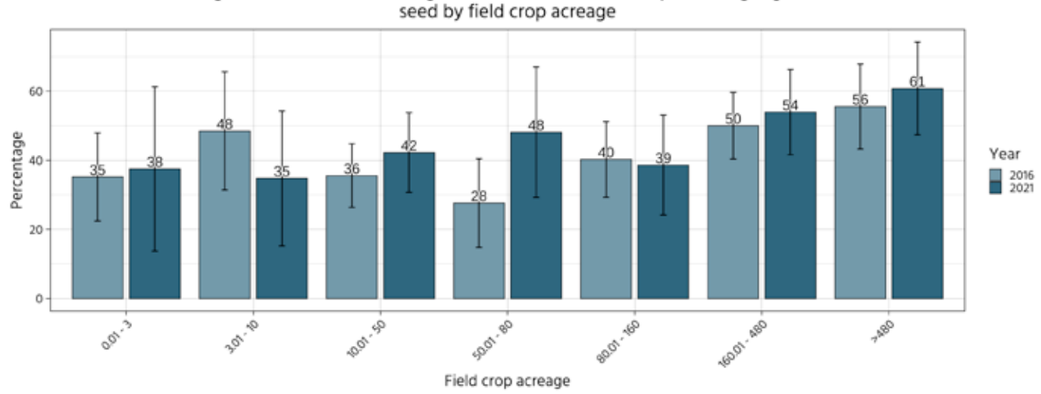


Figure 93. Lack of desirable genetic traits a factor in not purchasing organic seed by forage crop acreage

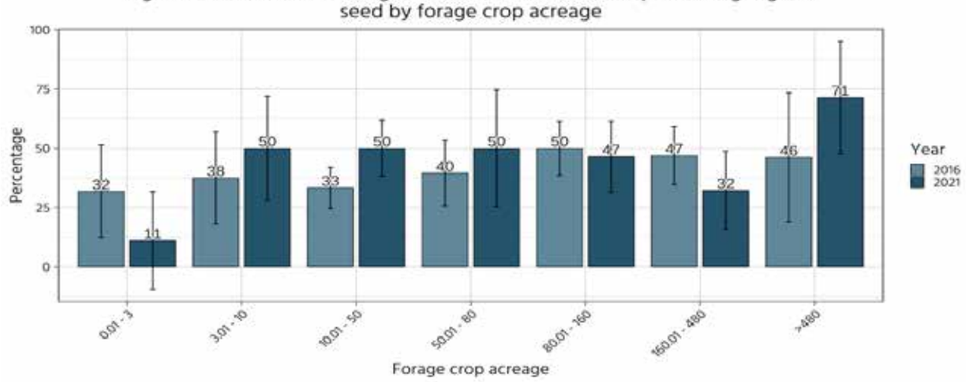


Figure 94. Seed companies should conduct testing and report rates of ge (gmo) crop contamination in organic and conventional seed

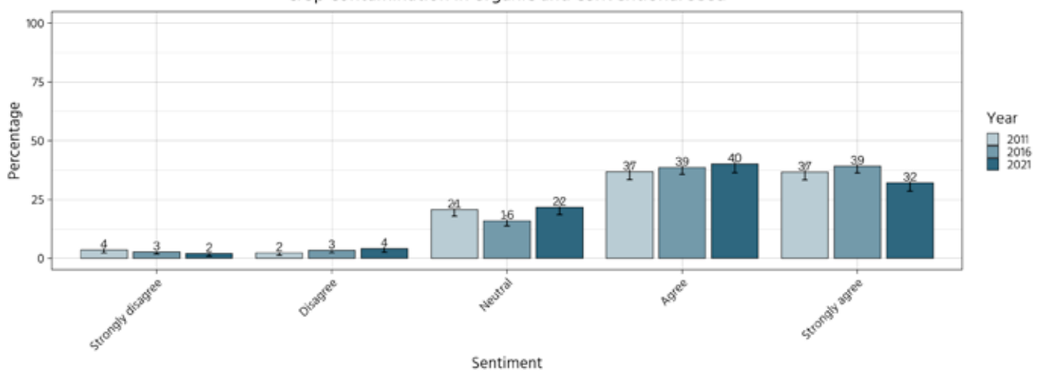


Figure 95. The federal regulations that oversee ge crop (gmos) approvals are adequate for protecting my organic farm product(s) from potential contamination by ge crops (gmos)

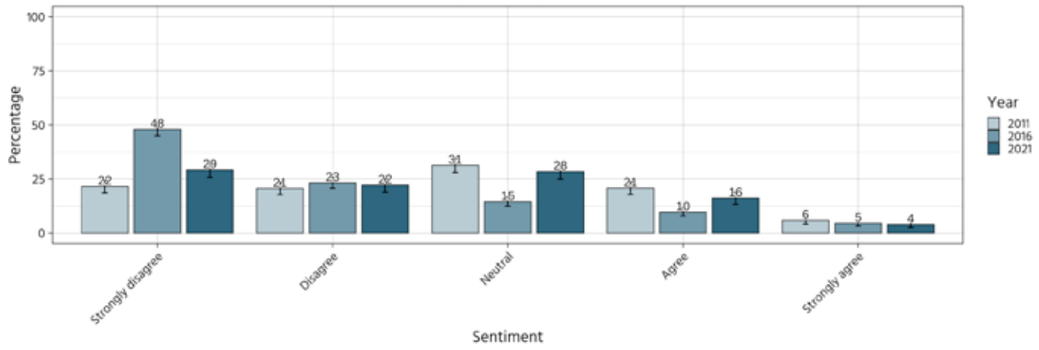


Figure 96. Unintentionally planting ge-contaminated seed on my farm puts at risk the integrity of my organic products

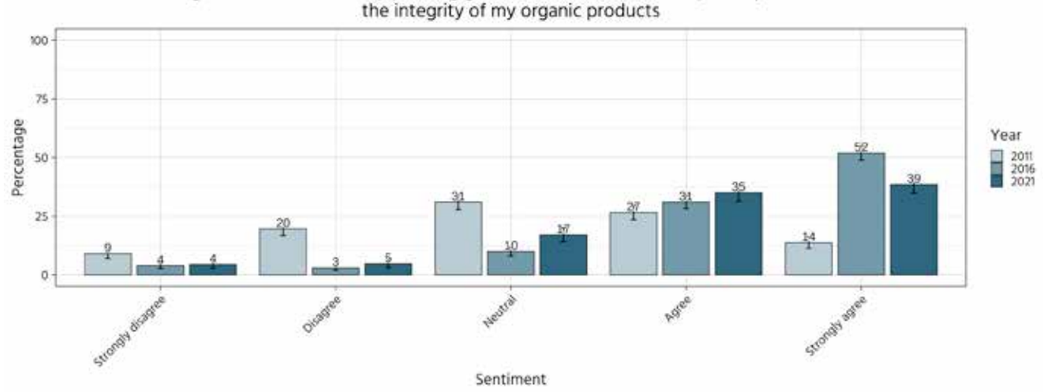


Figure 97. Organic seed is important to the integrity of organic food production

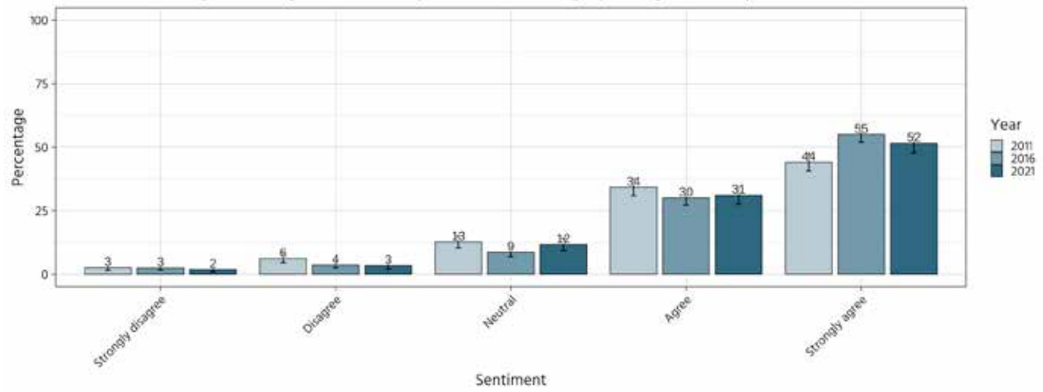


Figure 98. Varieties bred for organic production are important to the overall success of organic agriculture

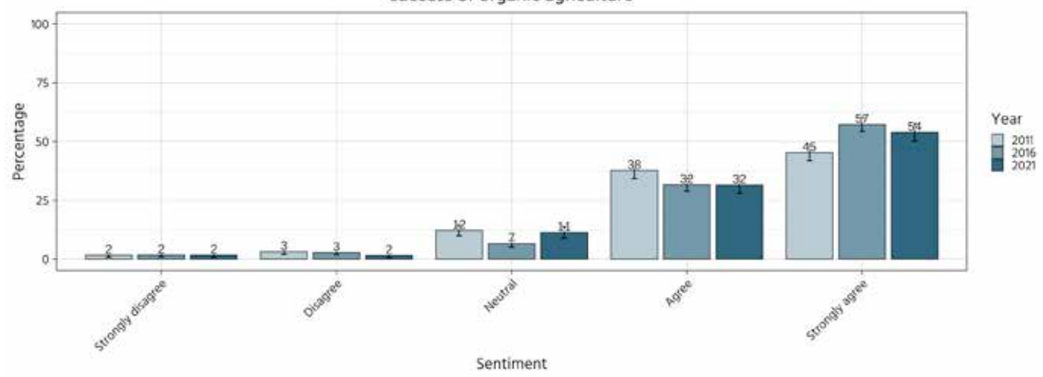


Figure 99. Do you think there are crops in need of organic plant breeding?

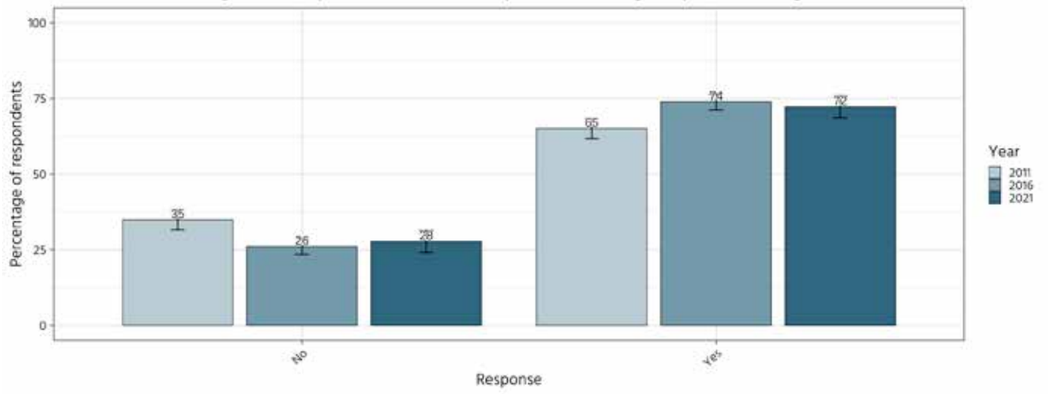


Figure 100. Top 10 crops in most need of improvement

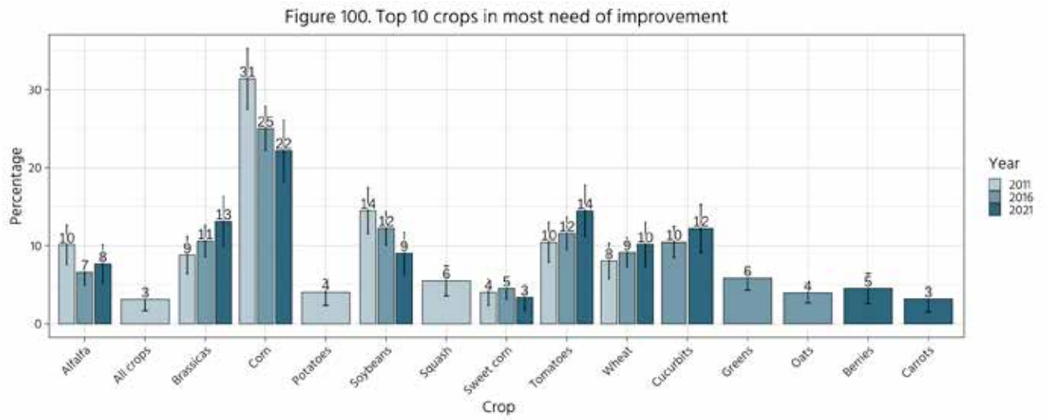


Figure 101. Average percent acreage planted to organic seed by crop type

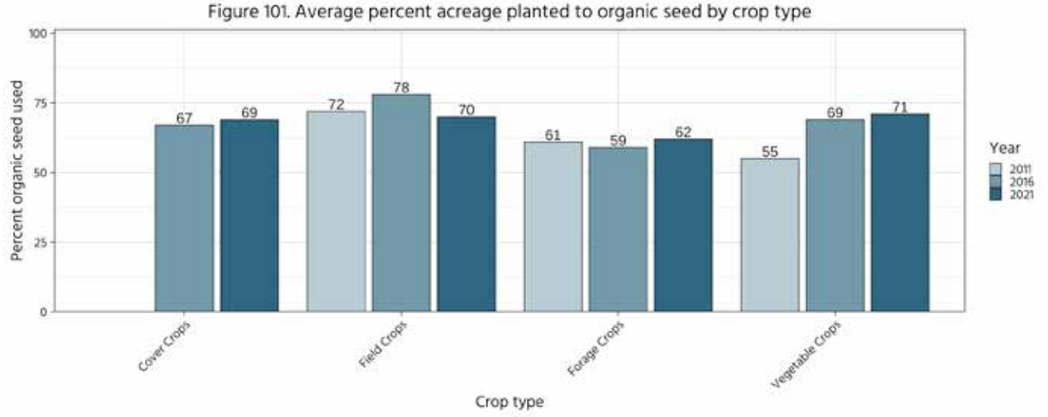


Figure 102. Percent of total acreage planted to organic seed by crop type

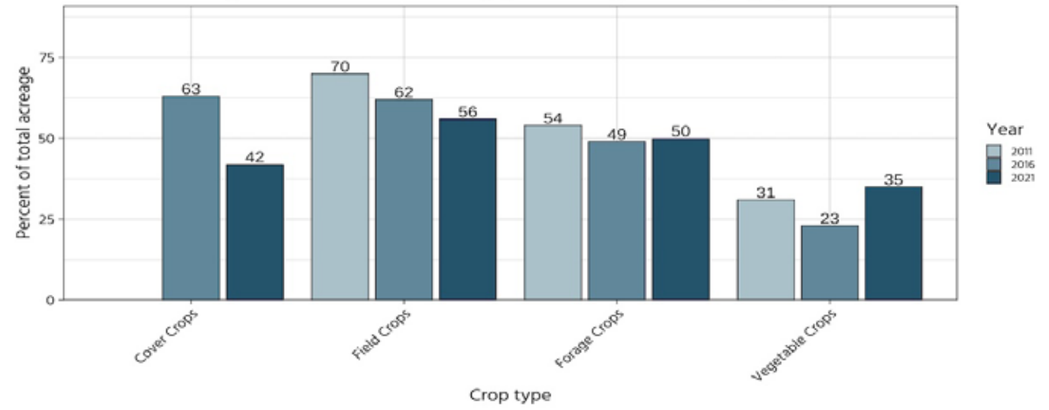
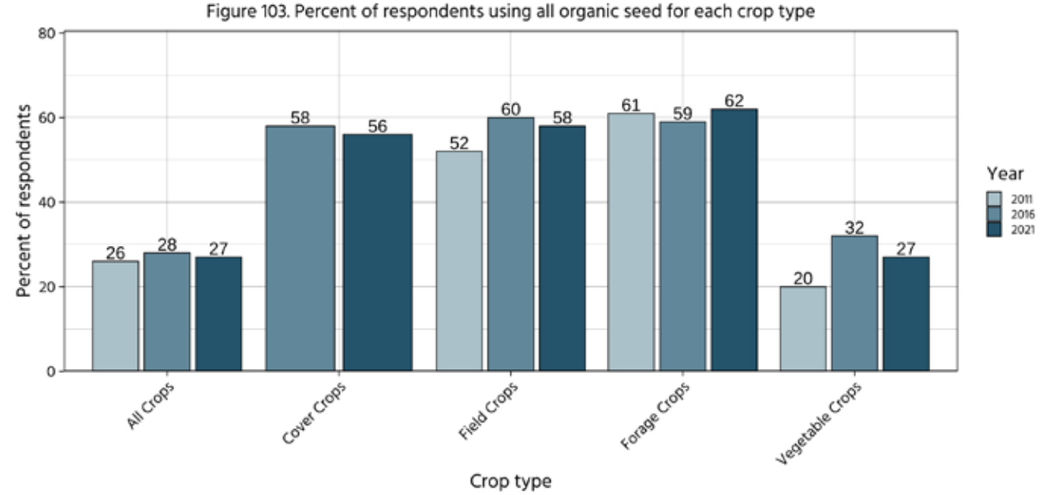


Figure 103. Percent of respondents using all organic seed for each crop type



Appendix C: Seed Producer Survey

Figure 1. Map of organic seed producer/company survey responses

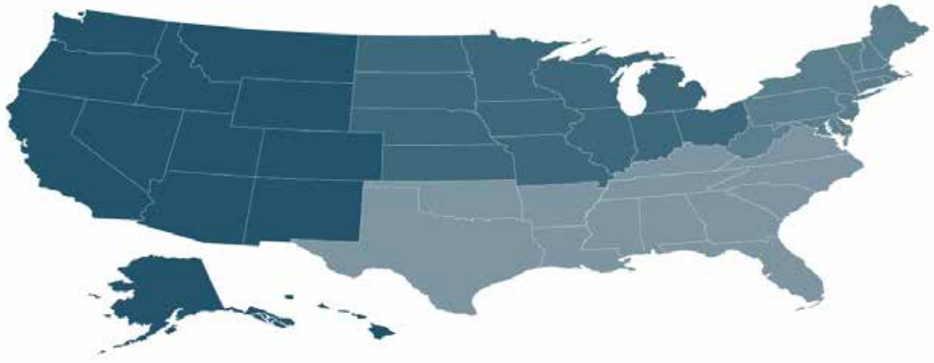


Figure 2. Crops produced over the last five years

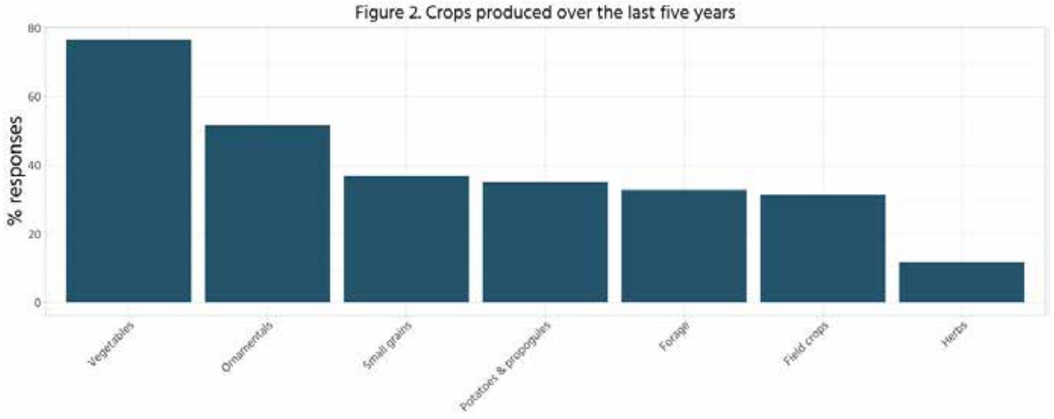


Figure 3. Operation annual revenue

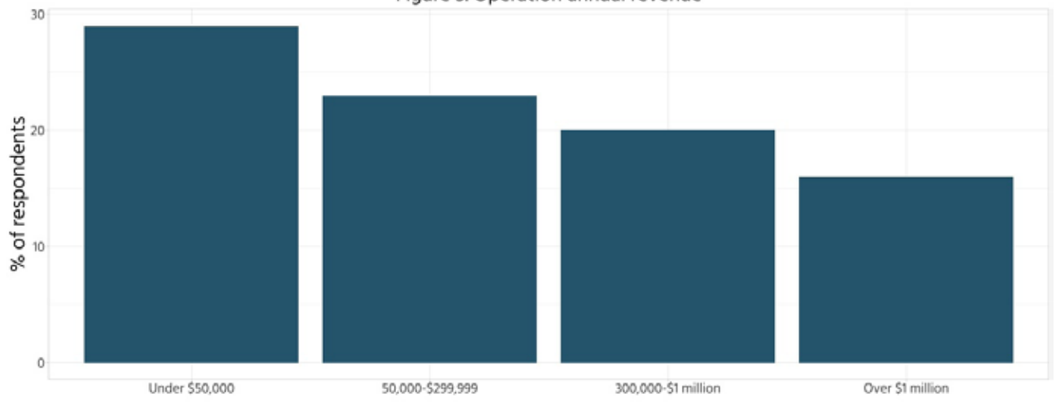


Figure 4. Years in organic farming and seed production

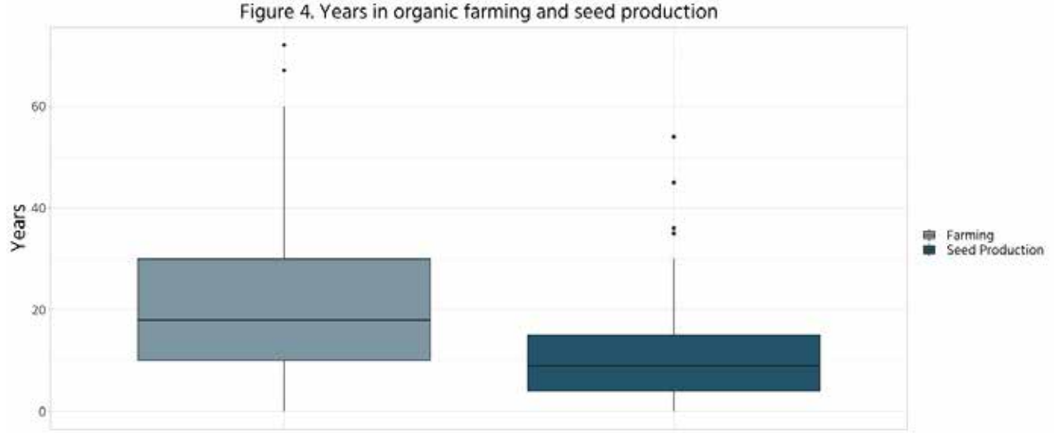


Figure 5. Organic seed producer production challenges

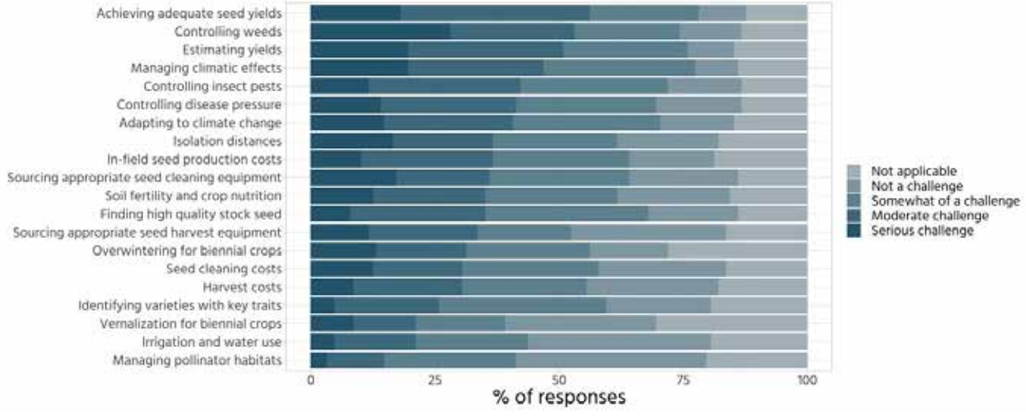


Figure 6. Organic seed producer non-production challenges

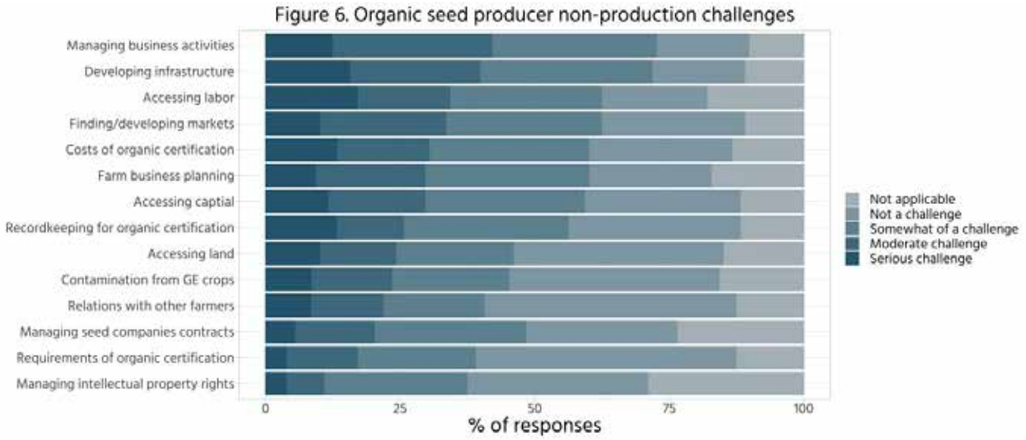


Figure 7. Seed producer/company views on IPR strategies

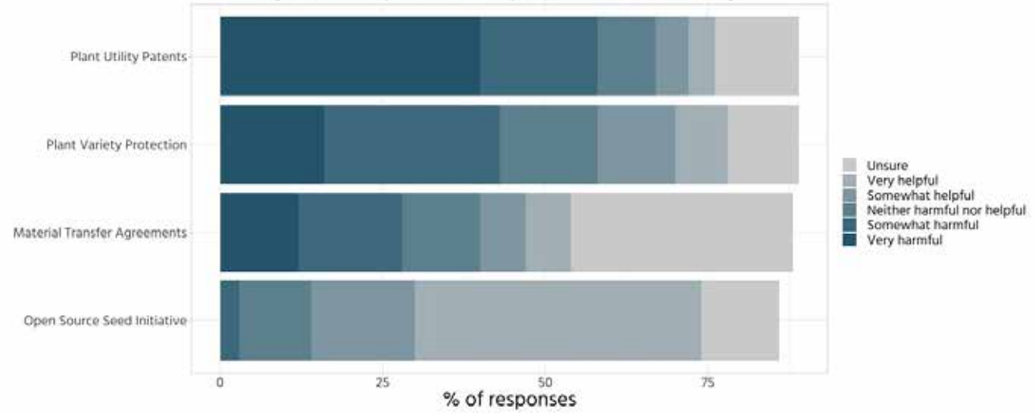
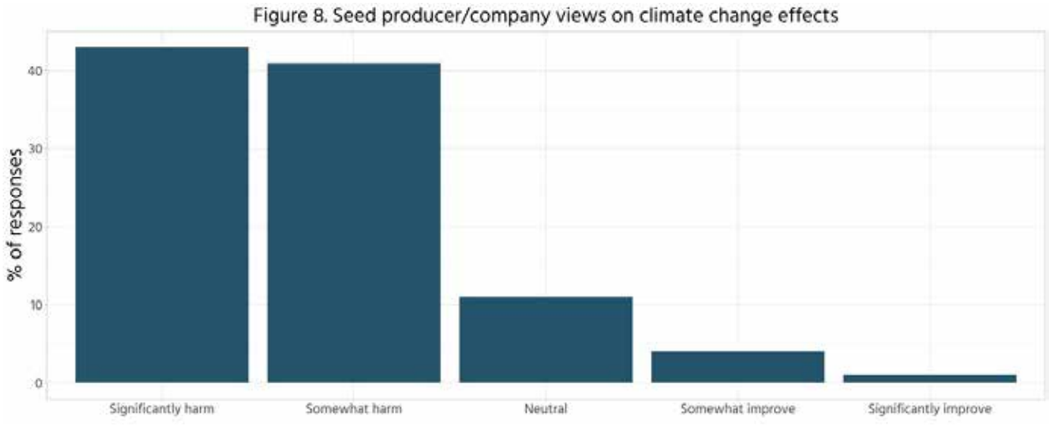


Figure 8. Seed producer/company views on climate change effects



Appendix D: Researcher Survey

Figure 1. Map of organic seed researcher survey responses

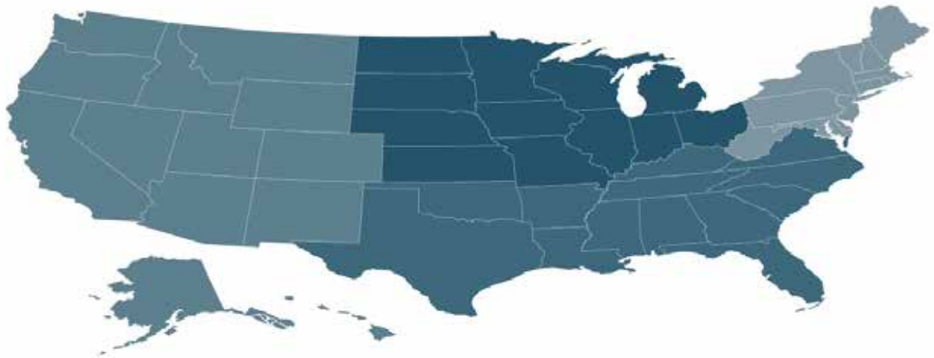


Figure 2. Crops organic seed researchers specialize in

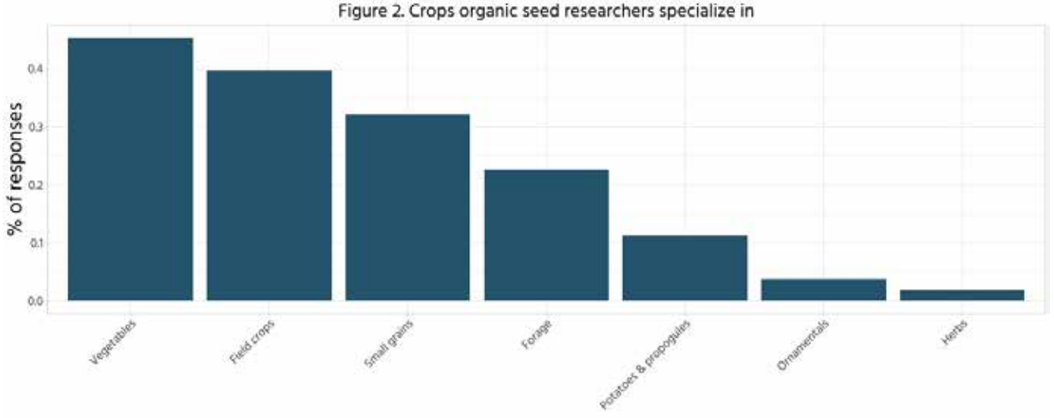


Figure 3. Organic seed work research expertise

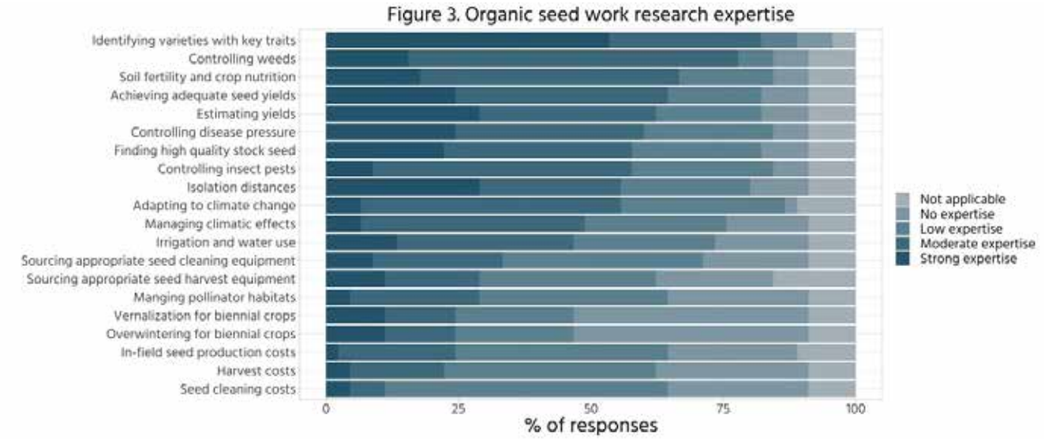


Figure 4. Disciplinary specialities

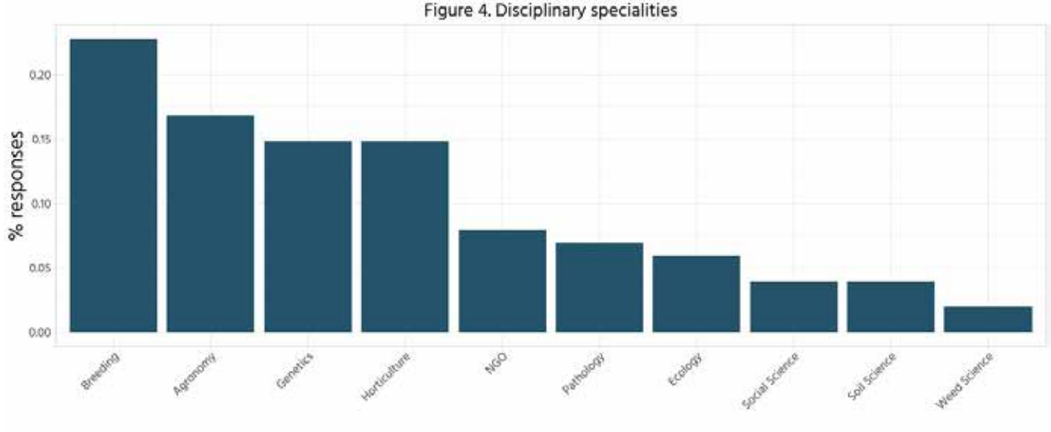


Figure 5. Successes of organic seed research projects

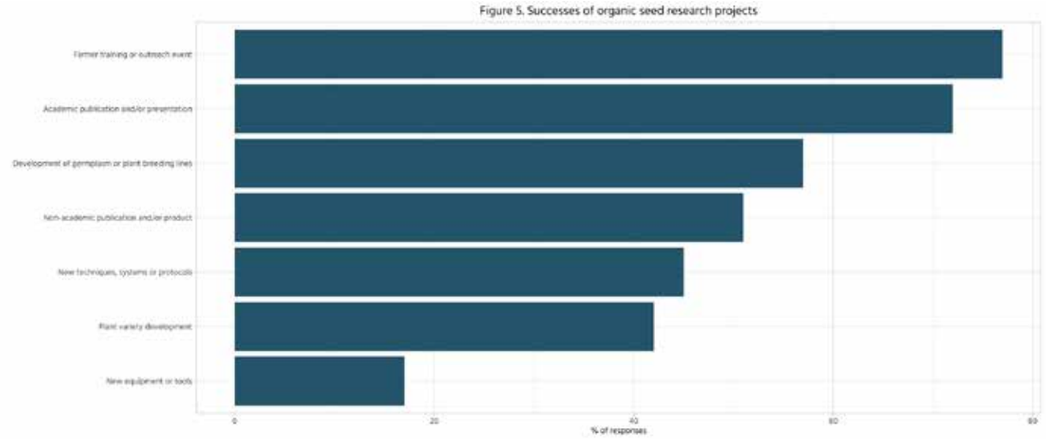


Figure 6. Challenges of organic seed research projects

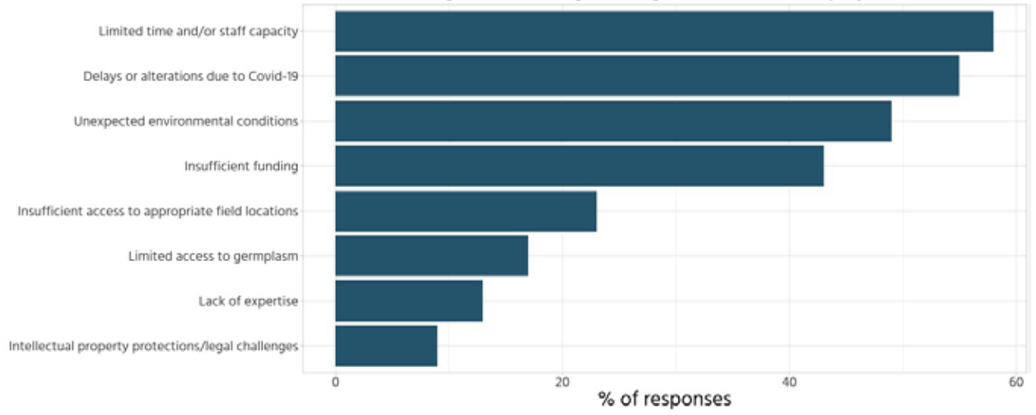


Figure 7. Finished varieties from organic seed research projects

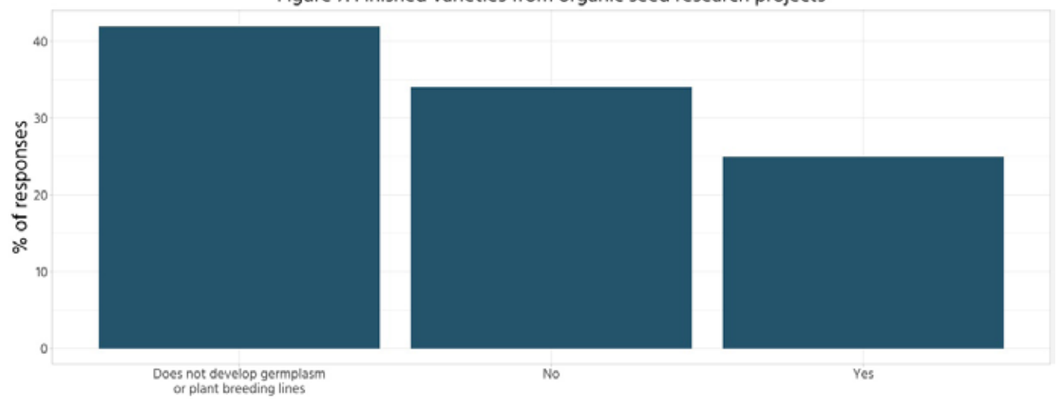


Figure 8. Mechanisms used to protect released material

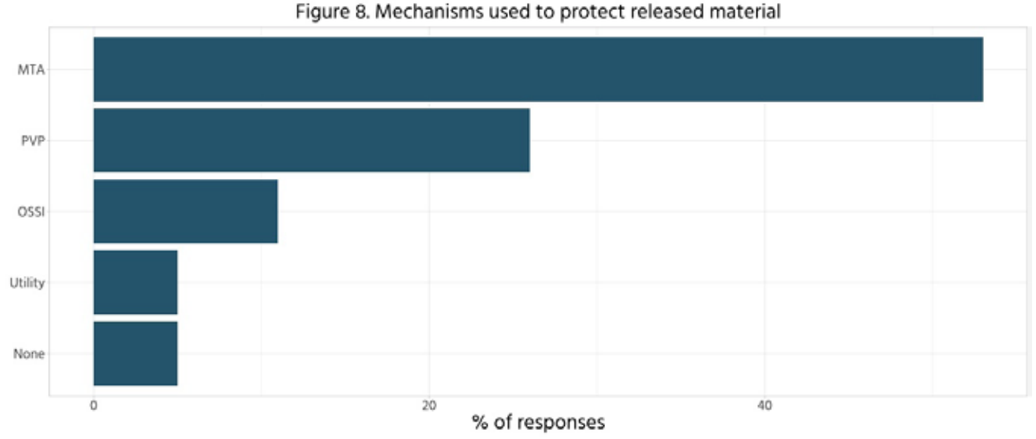


Figure 9. Seed researcher views on IPR strategies

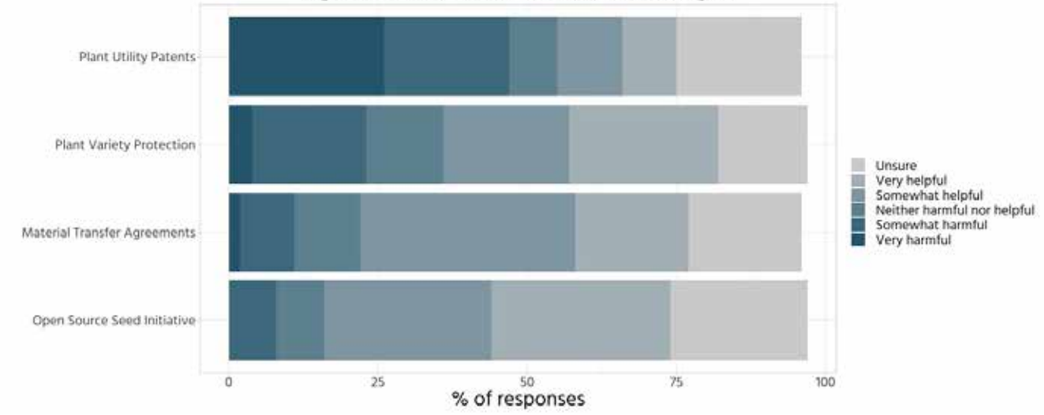


Figure 10. Seed researcher views on climate change effects

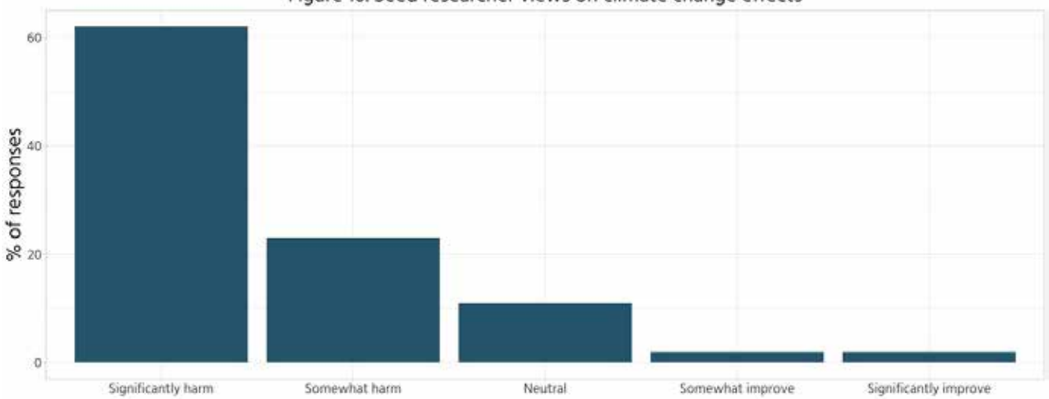
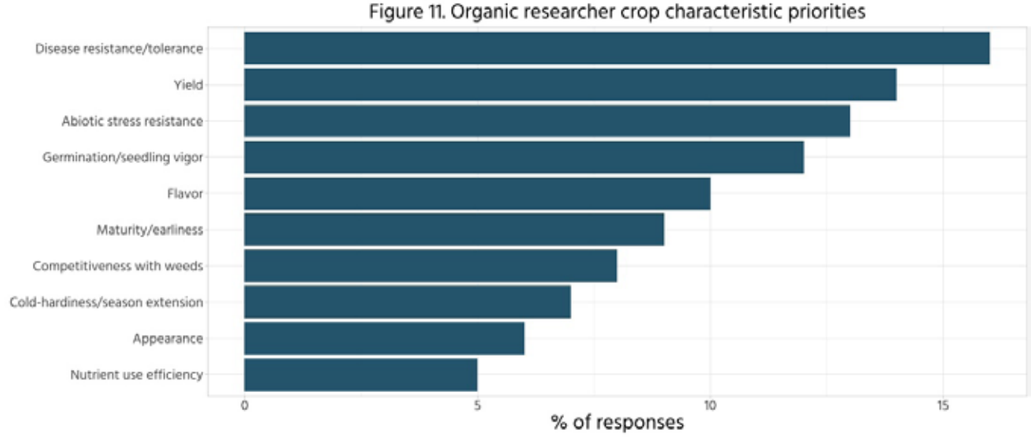


Figure 11. Organic researcher crop characteristic priorities



Appendix E: Research Funding

PROJECT NAME	RECIPIENT ORGANIZATION	STARTING YEAR	SOURCE	FUNDING AMOUNT
Breeding / Variety Trials				
20 to 20, in 2020	Rocky Mount Seed Alliance	2020	OFRF	$14,575
A conference grant to bring together scientists and industry partners to advance a dedicated breeding system for organic wheat varieties	Heartland Plant Innovations, Inc	2019	Other Federal Funds	$45,000
Accelerating Corn Elite Selections (ACES) Organic Breeding Program: Novel Strategies to Develop Field & Sweet Corn For Organic Producers	Iowa State University	2017	OREI	$1,000,000
Addressing the needs of organic direct-market growers for production and quality traits in vegetable seed	University of Wisconsin	2016	OREI	$49,969
Advancing the development of seed-propagated hybrid varieties in strawberry for organic agriculture	University of New Hampshire	2017	OREI	$467,902
An experiential learning-based public plant breeding pipeline for organic cultivar development	University of California	2015	OREI	$999,955
Barley And Alternative Crop Breeding Program In Washington State	Washington State University	2012	Clif Bar Family Foundation	$125,000
Breeding And Agronomy Of Quinoa For Organic Farming Systems	Washington State University	2016	OREI	$1,999,950
Breeding and testing corn for organic farmers that combines high N efficiency, superior nutritional value, and cross incompatibility.	Mandaamin Institute	2015	Other Non-Federal Funds	$177,154
Breeding Biofortified Pulse and Cereal Crops for US Organic Cropping Systems	Clemson University	2018	OREI	$998,510
Breeding Day-Neutral Strawberry Cultivars For Organic Production In The Pacific Northwest	Washington State University - Puyallup	2012	OFRF	$11,200
Breeding New Organic Oat And Wheat Varieties To Enhance Economic And Environmental Performance In Western Washington	Washington State University	2013	Clif Bar Family Foundation	$125,000
Breeding Non-Commodity Corn For Organic Production Systems	ARS	2014	OREI	$1,968,656
Breeding Organic Corn Varieties To Resist GMO Contamination	University of Tennessee	2012	SARE	$48,153
Breeding Organic Cotton Cultivars with Distinct Morphological Marker for Purity Maintenance	Texas A&m University	2017	OREI	$783,237
Breeding Sweet Corn For Organic Farming Systems	University of Wisconsin-Madison	2012	Clif Bar Family Foundation	$125,000
Bringing Small-Grain Variety Development And Selection Onto Organic Farms	North Dakota State University	2002	SARE, Other Non-Federal Funds	$106,022
Carrot Improvement For Organic Agriculture With Added Grower And Consumer Value	Agricultural Research Service	2011	OREI	$2,097,770
Carrot Improvement For Organic Agriculture: Leveraging On-Farm And Below Ground Networks	ARS	2021	OREI	$2,828,955
Climate Change, Mitigation, And Adaptation In Corn-Based Cropping Systems	Cropping Systems Coordinated Agricultural Project	2013	FAFO	$75,000
Collaborative plant breeding network development for organic systems in the Upper Midwest	University of Wisconsin	2020	OREI	$999,714
Collaborative Release, Testing, And Development Of Public Sector Multi-Use Barley Varieties For Organic Growers	Oregon State	2016	OREI	$1,999,979
Combination Of Major Genes For Improvement Of Organic Specialty Corn Varieties (Comgi)	Iowa State University	2021	OREI	$1,438,460
Corn Earworm Management: A Survey of Organic Sweet Corn Growers	University of Wisconsin	2017	OFRF	$3,588
Corn Variety Performance Trials For Ohio Organic Farmers	The Ohio State University	2001	OFRF	$8,280
Creating An Organic Plant Breeding Center	North Carolina State University - Crop Science	2012	OREI	$1,262,855
Creation Of Two Open-Pollinated, Sugary Enhanced Sweet Corn Varieties	Lupine Knoll Farm	2010	OFRF	$34,830
Developing "Organic-Ready" Maize Populations With Gametophytic Incompatibility	Dickinson Research Extension Center	2011	OFRF	$35,200
Developing A Public Domain Seed Bank For The Ozark Bioregion	Elixir Farm	2006	SARE	$17,095
Developing Adapted Varieties And Optimal Management Practices For Quinoa In Diverse Environments	Washington State University - Crop & Soil Sciences	2012	OREI	$1,603,653

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Breeding / Variety Trials				
Developing Multi-Use Naked Barley For Organic Farming Systems II	Oregon State University	2020	OREI	$2,000,000
Developing Multi-Use Naked Barley For Organic Farming Systems	Oregon State	2017	OREI	$1,995,665
Developing Small Grains Cultivars And Systems Optimally Suited For Organic Production	University of Nebraska - Agronomy & Horticulture	2007	OREI	$775,937
Developing Wheat Varieties For Organic Agricultural Systems	Washington State University - Crop & Soil Sciences	2006	Other Federal Funds	$1,035,836
Development and Assessment of Bacterial Wilt and Downy Mildew Resistant Cucumber Seedstocks - Year Two	North Carolina AT&T University and University of Massachusetts	2019	OFRF	$19,948
Development Of Corn Borer-Resistant Corn For Organic Farming Systems.	Seed We Need	2006	OFRF	$37,875
Development Of Cultivars And IPM Strategies For Organic Cotton Production	"Lubbock-TAMU Agr Res Cntr TEXAS A&M UNIVERSITY"	2010	OREI	$793,724
Development of wheat varieties for organic farmers	Washington State University	2002	OFRF	$33,472
Establishing Breeding Populations In Corn, Broccoli, And Kale	Organic Seed Alliance	2007	OFRF	$11,834
Evaluating Corn Varieties In Pure And Mixed Stands For Organic Crop Production Across Three States In The Corn Belt	The Ohio State University	2006	SARE	$138,252
Evaluation of day-neutral strawberries	Washington State University	2008	OFRF	$38,640
Evaluation of glandular-haired, potato leafhopper resistant alfalfa for organic farming systems	Ohio State University	2004	OFRF	$9,418
Evaluation Of The Insect Resistance Of Interspecific Squash Hybrids	Green Dragon Farm	2011	SARE	$4,022
Expanding The Cover Crop Breeding Network: New Species And Traits For Organic Growers	Cornell University	2021	OREI	$3,000,000
Facilitating Compliance With National Organic Program Standards Through Organic Variety Trials	Oregon State University	2009	Other Federal Funds	$24,690
Farmer Driven Breeding: Addressing The Needs Of Southeastern Organic Field Crop Producers	North Carolina State University - Crop Science	2009	OREI	$1,174,942
Farmer-Based Evolutionary Participatory Plant Breeding For Organic Quinoa, Buckwheat, And Spelt	Washington State University	2010	OFRF	$14,177

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Breeding / Variety Trials				
Farmer-Led Development and Commercial Release of Improved Hard Red Spring Wheat Variety	Farm Breeder Club	2005	SARE	$17,995
Four Organic Breeding Guides: An Introduction To Organic Breeding; And Organic Breeding For Sweet Corn, Carrots, And Tomatoes	Organic Seed Alliance	2010	OFRF	$14,815
Identification Of Management Practices And Cultivars For Organic Hard-Winter Wheat Production	Utah State University	1996	SARE, Other Non-Federal Funds	$155,611
Identifying And Marketing Quality Open-Pollinated And Organic Cucurbit Seedstocks For Virginia	Twin Oaks Seed Farm	2014	SARE	$9,963
Identifying Heirloom And Specialty Varieties Resistant To Silver Scarf Disease For Organic Potato Production	University of Wisconsin-Madison	2011	Other Non-Federal Funds	$10,000
Identifying Potato Varieties With Increased Levels Of Mature Plant Resistance To	University of Wisconsin-Madison	2012		$9,999
Identifying Priorities And Opportunities To Advance Organic Plant Breeding In The Pacific Northwest	Organic Seed Alliance	2014	OREI	$33,000
Improving Soybean And Dry Bean Varieties And Rhizobia For Organic Systems	University of Minnesota - Agronomy & Plant Genetics	2011	OREI	$1,450,922
Improving The Consumer Quality Of Organic Dry Beans Through Plant Genetic Improvements And Innovative Processing Methods	ARS	2018	OREI	$500,000
Integrating Cultivar, Soil And Environment To Develop	Washington State University	2007		$11,500
Methods to breed field corn that competes better with weeds on organic farms.	Michael Fields Ag Institute	2000	OFRF	$12,000
Mideast Organic Corn Variety Trial	Kentucky State University Organic Agriculture Working Group	2013	FAFO	$50,000
New Buckwheat Varieties For Greater Sustainability	Northern Plains Sustainable Agriculture Society Farm Breeding Club	2013	SARE	$18,881
Northeast Organic Wheat	Heritage Wheat Conservancy	2006	SARE, Other Federal Funds, Other Non-Federal Funds	$246,445

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Breeding / Variety Trials				
Northern Vegetable Improvement Collaborative (NOVIC) 3	Oregon State	2018	OREI	$1,999,999
Northern Vegetable Improvement Collaborative (NOVIC) 2	Oregon State University	2014	OREI	$1,997,986
Northern Vegetable Improvement Collaborative (NOVIC)	Oregon State University	2009	OREI	$2,308,246
On-Farm Organic Soybean Variety Trials	Michigan State University Extension	2012	SARE	$199,153
Open Source Carrots	University of Wisconsin-Madison	2014	Other Non-Federal Funds	$9,981
Organic Barley Breeding	Washington State University	2012	Clif Bar Family Foundation	$125,000
Organic Breeding For Late Blight Resistance In Tomatoes	Oregon State University	2012	Clif Bar Family Foundation	$125,000
Organic Breeding Populations: Tomato Late Blight Resistance	Organic Seed Alliance	2005	OFRF	$10,068
Organic Brussels Sprouts In The Northeast: Variety, Pest Control, And Storage Trials	Blue Heron Farm	2011	SARE	$6,134
Organic Corn Varieties To Resist Contamination From Genetically Engineered Corn Pollen	North Carolina State University	2013	Clif Bar Family Foundation	$125,000
Organic Cotton Breeding	Texas A&M AgriLife Research	2013	Clif Bar Family Foundation	$125,000
Organic Crop Cultivar Selection For Great Plains States In The North Central Region	North Dakota State University	2010	Other Non-Federal Funds	$156,096
Organic Dry Bean Breeding	UC Davis	2014	Clif Bar Family Foundation	$36,000
Organic Food Barley: Developing Nutritious And Delicious Varieties For The Pacific Northwest	Washington State University	2014	OFRF	$15,000
Organic Participatory Plant Breeding Toolkit: Tools & Training In Participatory Breeding Projects For Researchers And Organic Farmers	Organic Seed Alliance	2011	OFRF	$12,021
Organic Potato Variety Trial In Michigan's Upper Peninsula	Wixtrom Natural Farms	2013	SARE	$2,246
Organic Seed Partnership	Cornell	2004	OREI, SARE, Other Non-Federal Funds	$1,195,883
Organic Tomato Breeding For Arthropod Resistance With A Focus On Protected Cultivation: A Planning Proposal	University of Kentucky	2015	OREI	$50,000

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Breeding / Variety Trials				
Organic Vegetable Breeding	Oregon State University	2012	Clif Bar Family Foundation	$25,000
Participatory Breeding and Testing Networks: A Maize Based Case Study for Organic Systems	University of Illinois	2017	OREI	$1,999,559
Participatory breeding of high-value wheat for the Northeast	Cornell University	2015	SARE	$14,996
Participatory Development Of An Open Pollinated Early Maturating Sweet Corn For Organic Production	University of Wisconsin	2013	Other Non-Federal Funds	$9,996
Participatory Plant Breeding To Improve Sweet Corn.	University Of Wisconsin	2009	OFRF	$14,795
Participatory Screening Of Broccoli Varieties For Organic Systems In Western NC	NCSU Mountain Horticultural Crops Research and Extension Center	2011	OFRF	$59,147
Participatory Variety Trials For Flavor, Quality And Agronomic Performance To Increase Direct-Market Opportunities And On-Farm Trialing Capacity For Organic Growers	University of Wisconsin-Madison	2014	Other Non-Federal Funds	$10,000
Plant Breeding And Agronomic Research For Organic Hop Production Systems	Washington State University - Crop & Soil Sciences	2009	OREI	$410,077
Practical Approach To Controlling Foliar Pathogens In Organic Tomato Production Through Participatory Breeding And Integrated Pest Mgmt	Purdue University	2014	OREI	$1,987,150
Practical Perennials: Partnering With Farmers To Develop A New Type Of Wheat Crop	Michigan State University	2009	OREI	$1,049,674
Public Seed Initiative	Cornell	2003	OFRF	$23,636
Quinoa Trial For Northeast Upland Farms	Maplebank Farm	2012	SARE	$9,370
SCOPE 2.0: Refining organic breeding pipelines to produce improved varieties and workforce	University of California	2020	OREI	$999,694
Selecting For Resilience In Low-Input Potato Cropping Systems: Connecting Farmers And Breeders With The Genetic Resources Of An Underutilized Potato Germplasm Collection	University of Wisconsin - Madison	2012	SARE	$190,512
Small-grain cultivar selection for organic systems	North Dakota State University	2001	OFRF	$7,706

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Breeding / Variety Trials				
Snap Beans With Enhanced Nitrogen-Use Efficiency For Organic Production	University of Wisconsin	2012	OFRF	$29,213
Strengthening Public Corn Breeding To Ensure Organic Farmers' Access To Elite Cultivars	Agricultural Research Service	2010	OREI	$2,864,478
Superior Cover Crop Varieties for Organic Seed Production in the Maritime Northwest	Organic Seed Alliance	2009	OFRF	$14,884
Support to develop open-pollinated corn varieties for	Michael Fields Ag Institute	2000		$8,800
Sustainable, High-Quality Organic Pulse Proteins: Organic Breeding Pipeline For Alternative Pulse-Based Proteins	Clemson University	2021	OREI	$1,227,675
Tasting/Networking And Seed Access For Four Key Crops	Organic Seed Alliance	2013	Other Federal Funds	$64,246
Trialing And Seed Increase Of Promising New Vegetable Varieties For Organic Systems	Cornell	2009	OFRF	$14,953
Value-added Einkorn for Organic Production in the Great Plains Region	USDA North Central Soil Conservation Research Laboratory	2015	Other Non-Federal Funds	$0
Value-Added Grains For Local And Regional Food Systems II	Cornell University	2019	OREI	$47,629
Value-Added Grains For Local And Regional Food Systems	Cornell University	2011	OREI	$4,356,999
Washington State University Graduate Fellowship	Washington State University - Pullman	2013	Clif Bar Family Foundation	$81,250
Whole System Seed: Crop Breeding For Sustainable	Shoulder To Shoulder Farm	2001		$15,578
Enterprise Development				
Family Farmers Seed Cooperative	Organic Seed Alliance	2008	Other Federal Funds	$120,000
Siskiyou Sustainable Cooperative	Siskiyou Sustainable Cooperative	2003	Other Federal Funds	$42,085
Specialty Organic Seed Marketing And Cooperative Development Project	Organic Seed Alliance	2008	Other Federal Funds	$33,000
Specialty Seed Producers Cooperative (Nogn)	Organic Seed Alliance	2009	Other Federal Funds	$84,000
Yellow Dent Organic Hybrid Seed Corn	Michael Jasa	2002	SARE	$6,000

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Multi-Topic				
Breeding corn to enable organic seed production	Agricultural Research Service	2020	OREI	$3,993,024
Building A Lasting Seed Development Network Through An Online Organic Seed Growers Conference	Organic Seed Alliance	2021	OREI	$46,252
Building Resilience And Flexibility Into Midwest Organic Potato Production: Participatory Breeding And Seed Potato Production	University of Wisconsin-Madison	2014	SARE	$199,106
CIOA 2- Carrot Improvement For Organic Agriculture With Added Grower And Consumer Value	ARS	2017	OREI	$1,999,979
Creation Of Regional And Local Maize Food Systems (Products Integrating Breeders, Growers, Supply Chains And End Users)	University of Wisconsin - Madison	2021	OREI	$42,749
Development A Healthy Regional Sustainable Seed System In Northern California	Organic Seed Alliance	2013	Other Non-Federal Funds	$60,000
Development Of Sustainable Seed Systems In Northern California	Organic Seed Alliance	2010	Other Non-Federal Funds	$23,200
Farm Breeder Club	North Dakota State University	2002	Other Non-Federal Funds	$33,069
Farm-Based Selection And Seed Production Or Varieties Of Bread Wheat, Spelt, Emmer, And Einkorn Adapted To Organic Systems In The Northeast	Cornell University	2012	SARE	$196,743
ICORP: Increasing Coastal Organic Rice Production In South Carolina Using Salt Tolerant Cultivars	Clemson University	2021	Other Federal Funds	$600,000
Integrated Disease Management Strategies For Key Disease(S) In Organic Tomato Production System	North Carolina State University	2021	Other Federal Funds	$600,000
Native Seeds/SEARCH - Creating A Robust And Healthy Food System	Native Seeds/SEARCH	2011	Clif Bar Family Foundation	$6,000
On-Farm Variety Trials: Guidelines And Field Trainings For Organic Vegetable, Herb And Flower Producers	Organic Seed Alliance	2006	Other Federal Funds	$115,059
Organic Certified Seed Potato Production In The Midwest	University Of Wisconsin	2007	OFRF, OREI	$570,656
Organic Seed Alliance	Organic Seed Alliance	2011	Clif Bar Family Foundation	$70,610
Organic Seed Growers Conference	Oregon State University	2007	SARE	$3,615

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Multi-Topic				
Restoring Our Seed	Heritage Wheat Conservancy	2002	SARE, Other Federal Funds, Other Non-Federal Funds	$204,000
Seed Matters	OFRF	2014	Other Non-Federal Funds	$50,000
Selection To Distribution: Delivering Regionally Adapted Cover Crop Varieties To Organic Farmers	ARS	2018	OREI	$1,997,837
Strengthening The Organic-Seed System In California	Organic Seed Alliance	2011	Other Non-Federal Funds	$30,000
Tomato Organic Management And Improvement Project (TOMI): Part 2	Purdue University	2019	OREI	$1,999,614
Policy				
Advocating For The Future Of Organic Agriculture And Crop Diversity	Rural Advancement Foundation International	2013	FAFO	$30,000
Organic Carrots And Impact Of Patents On Plant Genetic Diversity	University of Wisconsin-Madison	2013	Clif Bar Family Foundation	$125,000
Organic Seed Alliance Advocacy	Organic Seed Alliance	2012	FAFO	$75,000
Organic Seed Working Groups	Organic Seed Alliance	2011	FAFO	$27,000
Public Plant Breeding Survey	University of Wisconsin - Madison	2014	Clif Bar Family Foundation	$25,000
Save Seed Sharing Campaign/Richmond Grows Seed Library	RICHMOND GROWS SEED LENDING LIBRARY	2012	Clif Bar Family Foundation	$2,000
Seeds And Breeds Conference	RAFI	2014	Clif Bar Family Foundation	$40,000
Seed Production Research and Education				
Non-GMO Parent Lines	Brownseed Genetics	2008	FAFO	$45,000
Assessment, Detection and Innovative Treatment Methods for Seed Borne Diseases in Organic Wheat and Barley Seed Production	Ext - University of Vermont Extension	2016	Other Federal Funds	$324,560
Building farmer capacity to produce and market vegetable seed in Minnesota through seed production trials and education	Organic Seed Alliance	2019	SARE	$40,000
Can Organic Garlic Seed Stock Be Created Disease-Free From The Production Of Garlic Bulbils?	Honeyhill Farm	2013	OFRF	$8,906

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Seed Production Research and Education				
Classroom and Field-based Training to Assist Beginning Farmers Entry into Organic Seed Production	Organic Seed Alliance	2015	Other Federal Funds	$251,237
Climatic Risk Management Publication And Trainings For Organic And Specialty Vegetable Seed Producers - Including Hispanic Producers.	Organic Seed Alliance	2012	RMA	$82,063
Connecting community to strengthen organic seed breeding and research	Organic Seed Alliance	2020	OREI	$41,910
Cowpea And Forage Radish Cover Crop Seed For Northern Climates	Northern Plains Sustainable Agriculture Society	2012	SARE	$199,776
Effect Of Compost Extracts On Organic Seed Germination And Reduction Of Weed Seed Expression	The Rodale Institute	2013	OFRF	$14,376
Enhancing organic seed health, seedborne disease diagnostics and bio-control systems for organic vegetable crops in Southeastern US	1890 - Alabama A&M University	2020	Other Federal Funds	$598,094
Enhancing Seed Production of Regionally Adapted Crops in the Southeastern Farmer Seed System	University of Florida	2019	SARE	$310,537
Feasibility Of Small-Scale Certified Organic Seed Production, Marketing, And Sales	Chickadee Farm	2014	Other Federal Funds	$5,000
Hybrid Seed Production Techniques For Cucurbita Pepo In Organic Agricultural Systems	High Mowing Seed Company	2007	Other Federal Funds	$80,000
Improving Seed Quality Of Northeast-Grown Seed: Focus On Disease	Hudson Valley Seed Library	2013	SARE	$14,940
Managing Indigenous Seed-Inhabiting Microbes For Biological Control Against Fusarium Pathogens In Corn	Oregon State University	2013	OFRF	$13,000
Microbial Seed Treatments	Ohio State University	2005	OFRF	$23,340
Northeast Organic Seed Conference: Strengthening the Regional Organic Seed Sector	University of Vermont	2020	OREI	$49,974
Optimizing Sorghum-Sudan/Forgae Soybean Cover Crop Populations And Screening Sorghum Varieties For Organic Cover Crop Performance, Forage, And Seed Production In The Northern Great Plains Region	Berry Farm	2010	SARE	$17,912
Organic cover crop seed production as a sustainable enterprise for the Southeast	University of Georgia Extension	2009	OFRF	$2,536

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Seed Production Research and Education				
Organic Seed Production And Improvement Training Program For Vermont	North East Organic Farming Association	2013	OFRF	$9,195
Organic Seed Production for Beginning Farmers: An Internship Program, On-line Course, and National Co-learning Community	Organic Seed Alliance	2019	Other Federal Funds	$589,424
Organic Seed Production Guides	Organic Seed Alliance	2009	OFRF	$13,614
Organic Seed, Soils, And Sustainable Business: Three Intensives And An Online Tutorial	Organic Seed Alliance	2010	SARE	$76,712
Organic Seed: Increasing Regional Organic Farming Capacity Through Shared Learning Around Research, Development, Production And Marketing	Greenbank Farm	2012	Other Federal Funds	$141,000
Perceptions And Use Of Organic Seed And Varieties By Midwestern Organic Vegetable Growers	University of Wisconsin-Madison	2011	Other Non-Federal Funds	$9,584
Planning for Organic Seed Production Research	Organic Seed Alliance	2020	OREI	$35,105
Pollinator Conservation Strategies For Organic Seed Producers	Xerces Society for Invertebrate Conservation	2012	FAFO	$15,000
Producing Organic Vegetable Seed	Organic Seed Alliance	2004	SARE	$154,293
Saving Our Seed	Carolina Farm Stewardship Association	2003	SARE	$204,500
Seed Growers' Handbook: Producing Vegetable Seeds For Sustainable Agriculture	Seedmovement	2003	SARE	$62,925
Seed Saving Farmer Training	Rocky Mountain Seed Alliance	2018	SARE	$45,350
Seedling Diseases And Seed Treatments	Washington State University	2009	Other Federal Funds	$40,000
The Community Seed Resource Program	Seed Savers Exchange	2013	Clif Bar Family Foundation	$51,560
Training Seed Producers and Increasing Local Markets for Seed Production	Oregon State University	2017	SARE	$49,750
Trial of beneficial microbial seed treatments in organic farming systems	Cornell	2004	OFRF	$5,429
Vacant lots to Abundant Farms: Water collecting, composting, and seed saving to turn vacant lots into self-sustaining community gardens and businesses.	The Good Stuff Gardens	2015	SARE	$7,129
Weather-Related Risk Reduction Guidelines For Vegetable Seed Growers	Organic Seed Alliance	2005	Other Federal Funds	$9,269

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Systems Development				
A National Agenda For Organic And Transitioning Research	OFRF	2019	OREI	$499,646
Farmer Seed Stewards Program	Organic Seed Alliance	2012	Clif Bar Family Foundation	$45,000
Hua Ka Hua - Restore Our Seed; A Symposium To Develop A Hawaii Public Seed Initiative	The Kohala Center	2009	OREI	$47,500
Organic Seed Producer Database	Organic Seed Alliance	2006	SARE	$15,960
Organic Seed Production: Materials, Training, And A Seed Database	OMRI, OSU, OSA	2006	SARE	$98,755
Planning For Organic Plant Breeding And Seed Production In The Southeast	Organic Seed Alliance	2014	OREI	$42,951
Southern Organic Seed Summit	Organic Seed Alliance	2019	SARE	$49,957
Sustainable And Organic Roundtable	Center For Rural Affairs	2006	Other Federal Funds	$3,000
The Seed We Need - Working Group, Symposium, And Action Plan For The Advancement Of Organic Seed Systems	Organic Seed Alliance	2009	FAFO, OREI	$56,281
The Student Organic Seed Symposium: Supporting and educating future leaders in organic seed and plant breeding	University of Wisconsin	2015	OREI	$49,992