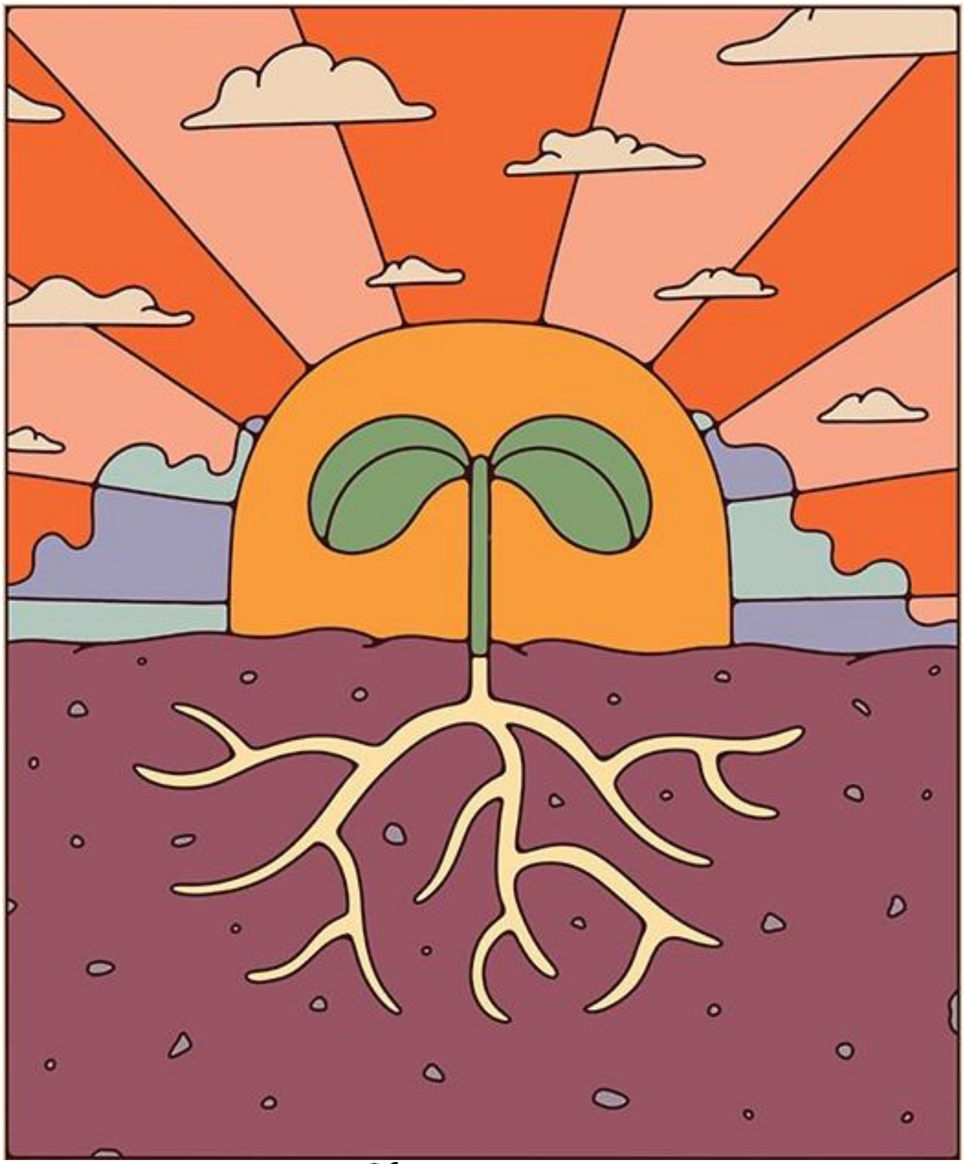
Proceedings of the 11th Organic Seed Growers Conference

Feb 4th – 11th, 2022 | Virtual



Organic Seed Alliance • P.O. Box 772 Port Townsend, WA 98368
360-385-7192 • www.seedalliance.org • info@seedalliance.org

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Many thanks to the conference planning committee:*

Bonnetta Adeeb, Steam Onward & Ujamaa Cooperative Farming Alliance

Jay Bost, GoFarm Hawaii

Alice Formiga, eOrganic

Rue Genger, University of Wisconsin-Madison

Nate Kleinman, Experimental Farm Network

Rebekah Korenowsky Woods, Organic Seed Alliance

Cara Loriz, Organic Seed Alliance

Michael Lordon, Organic Seed Alliance

Petra Page-Mann, Fruition Seeds

Natalia Pinzón Jiménez, Farmer Campus

Karl Sutton, Fresh Roots Farm

Alexis Yamashita, Ujamaa Farming Cooperative & Southern Exposure Seed Exchange

A very special thanks to our conference chair: Cathleen McCluskey, Organic Seed Alliance

*We received over 75 conference proposals. A total of 25 members of the organic seed community reviewed these proposals and provided input on the agenda, including seed growers, policy advocates, graduate students, university plant breeders, and seed and food companies.

Our mission

Organic Seed Alliance advances ethical seed solutions to meet food and farming needs in a changing world. We accomplish our mission through research, education, and advocacy programs that closely engage farmers and other seed community members.

Our vision

We envision organic seed systems that are democratic and just, support human and environmental health, and deliver genetically diverse and regionally adapted seed to growers.

Our work

OSA has a 19-year track record in addressing seed industry consolidation through fostering regional seed networks that result in transformative change at the national level. Our **research** expands access to high-quality organic seed through participatory plant breeding and other research that emphasizes diversity, ecology, and shared benefits to meet regional and national seed and food needs. We provide **education** in on-farm plant breeding and seed production through events and publications in order to build the base of knowledge necessary for stewarding seed and enhancing biological diversity. Our **advocacy** work promotes the benefits of organic seed while simultaneously confronting threats to organic seed systems by engaging in policy actions, discussions, and research at the national level.

Our values

Action: We value taking action to support seed growers and to remove structural barriers to a just and equitable seed and food system.

Civility: We value civil discourse on issues that matter to our constituents.

Collaboration: We value public participation in decision-making – in the field and in policy – beginning with the grassroots, resulting in the co-creation of knowledge and shared solutions.

Community rights: We value a community's right to determine whether and how culturally important seed are used and shared.

Diversity: We value genetic, biological, cultural & social diversity in our seed and food system.

Equity: We value the equitable treatment of all individuals and equitable rights for all, and the equitable exchange of seed with appropriate acknowledgement and compensation.

Fairness: We value fair competition, labor, markets, and opportunities for all.

Farmers: We value the leadership and rights of farmers across time and scale in research, education, policy, seed stewardship, and food security.

Health: We value a healthy environment and the health of all species, including the right to clean air, soil, and water.

Inclusivity: We value an organizational and program environment that is inclusive of all.

Integrity: We value the integrity of seed and personal and professional integrity in the people who steward them.

Precaution: We value preventative actions and policy positions in the face of uncertainty.

Public good: We value actions, programs, and policies that aim to serve the public good first.

Gold Sponsors

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This conference was supported in part by a grant from the U.S. Department of Agriculture, National Institute of Food and Agriculture, Organic Agriculture Research and Education Initiative, Accession #1026618. This conference was also supported by the Beginning Farmer and Rancher Development Program from the USDA National Institute of Food and Agriculture. This conference was produced in partnership with eOrganic.

Conference Agenda — Friday, February 4

Opening Ceremony & Keynote Presentation by Jim Embry

Virtual Research Poster Session Q&A

Concurrent Sessions

- Next Steps for Organic Seed Production Education
- Breeding Barley for Organic Systems
- Perspectives on Seed Policy
- Black Seed Stories

Synergy Space Meet-Ups

- Vegetatively Propagated Crops
- Organic Seed Course Alumni

Happy Hour

Saturday, February 5

Movement with Indigenous Lotus: Yin Yoga for Grounding

Main Stage: Protecting Seed's Diversity: Maize, Mexico, and the Future of Biodiversity

Trade Show

Concurrent Sessions

- State of Organic Seed: A Five-Year Update
- Rocky Mountain Heritage Grain Trials
- Non-Binary Botany

Synergy Space Meet-Ups

- Small / Regional Seed Companies
- Youth Seed Growers
- ¿Qué esta pasando con las semillas en nuestras comunidades? Una conversación en español.

Sunday, February 6

Movement with Indigenous Lotus: Dynamic Movement & Flow

Main Stage: Race, Equity, and the Organic Movement

Lightning Talk Q&A

Concurrent Sessions

- Democratizing Crop Variety Trialing Through Community Science
- Perspectives on Organic Vegetable Legumes: Current Status and Breeding for the Future
- Addressing Seed Grower Concerns with Organic Certification
- Labor in the Organic Seed Movement

Synergy Space Meet-Ups

- Seed Internship Program – Potential Interns and Farms
- Seed Libraries

Tuesday, February 8

Synergy Space Meet-Ups

- Midwest Regional Seed Network
- Organic Seed Potato Certification

Movement with Indigenous Lotus: Indigenous Yoga Flow

Concurrent Sessions

- Small- to Medium-Scale Seed Cleaning Equipment: How to Make the Best of What You Have and Know What You Need
- The Power of Seed Names: Can We Do Better?
- Seed is Liberation

Synergy Space Meet-Ups

- Meet OSA
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- Seed Names Debrief & Further Conversation

Concurrent Sessions

- Seed Endophytes, Rhizophagy, Nutrient Density, Nitrogen Efficiency and Fixation in Corn
- UPOV and the Criminalization of Seed
- Discovering, Connecting, and Inspiring a Southeast Seed Network

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Synergy Space Meet-Ups

- Pacific Northwest Regional Seed Network
- Intermountain West Regional Seed Network
- California Regional Seed Network
- Hawaii Regional Seed Network
- Seed Equipment

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Synergy Space Meet-Ups

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Main Stage: The Heirloom Collard Project: A Model for Collaborative Seed Work

Trade Show

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- Student Collaborative Organic Plant Breeding Education: Cultivating New Varieties and Future Plant Breeders
- Lessons for the Organic Seed Movement from International Perspectives
- Bees As Seeds: The Importance of Place, Power, & Purpose in Seed Production and Pollination Conservation

Concurrent Sessions

- A Seed Policy Roadmap for the Pacific Northwest
- Assessing the Resilience of the Organic Seed System: A Network Perspective
- Running a Small Online Seed Company: From Growing to Managing Inventory to Packing to Shipping

Synergy Space Meet-Ups

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Main Stage: Seed Production for Market Growers

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Concurrent Sessions

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- Learnings From Participatory Grower Networks
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Movement with Indigenous Lotus: Indigenous Yoga Flow

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Welcome to the 11th Organic Seed Growers Conference

Welcome, Bienvenido, Bienvenue!

Thank you for being a part of the 11th Organic Seed Growers Conference this February 4th to 11th, 2022. The agenda includes 180+ presenters and 70+ virtual sessions on topics ranging from DIY seed equipment to seed policy to the impact of climate change on seed growers to non-binary botany to Black seed stories to labor in organic seed and so much more.

There are 1,200+ participants from 48 U.S. states and 39 countries joining us in co-creating this virtual gathering.

Among these are many folks new to the conference along with many familiar faces. This gathering is biennial like our brassica seed friends and this is it's 20th year. The first Organic Seed Growers Conference was in 2002, a small gathering of seed growers in the Pacific Northwest of the U.S. The event was hosted by a seed company that would become Organic Seed Alliance, rising from the ashes of a fire that destroyed the seed in storage leaving only the seed in the growers' fields. This confirmed the direction that the company was headed – away from selling seed and towards teaching farmers how to grow seed and adapt varieties to local climates, with an understanding that their impact could be so much bigger as a convener and as an educator.

The last time this conference was held was in person in February of 2020. Many folks could feel big changes, big shifts in their bones, in our conversations. We were starting to hear about something called COVID, saw a few masks floating around the 500-person crowd. We hugged. Danced. Shared food. Swapped seeds.

And then everything changed.

And here we are in the middle of big shifts. Two years into a pandemic. Tuning into a virtual space from across the Earth. Unsure what the next week, month, or year will bring.

But right now, today, we are here together connected by the seeds that we have the honor to steward, thanks to all who came before us and in service to all who will come after us.

This year, we're gathering on a new digital platform called Organic Seed Commons – a space where seed people can gather, learn, connect, meet new people, swap seed, and – well, whatever else you dream up for this space. It's all of ours.

There are so many people who've been a part of creating this conference and deserve recognition. First, deep thanks to our loving ancestors, and non-human relatives, for helping guide our conversations throughout the event.

Many thanks to the Conference Planning Committee who have poured their hearts and heads into this gathering. Committee members include: Bonnetta Adeeb, Steam Onward and Ujamaa Cooperative Farming Alliance; Jay Bost, GoFarm Hawaii; Alice Formiga, eOrganic; Rue Genger, University of Wisconsin-Madison; Nate Kleinman, Experimental Farm Network; Rebekah Korenowsky Woods, Organic Seed Alliance; Michael Lordon, Organic Seed Alliance; Cara Loriz, Organic Seed Alliance; Petra Page-Mann, Fruition Seeds; Natalia Pinzón Jiménez, Farmer Campus; Karl Sutton, Fresh Roots Farm; and Alexis Yamashita, Ujamaa Cooperative Farming Alliance.

Thank you to the technology team working tirelessly to create and hold the virtual space including three languages and 102 Zooms. The technology team is led by Rebekah Korenowsky Woods and includes Aba Kiser, Michael Lordon, James Haldane, Natalia Pinzón Jiménez, and Alice Formiga.

We're honored to welcome our keynote presenters Jim Embry from Sustainable Communities and Vivien Sansour founder of the Palestine Heirloom Seed Library. Jim's presentation during the Opening Ceremony sets the tone for the whole gathering, and Vivien's presentation during the Closing Ceremony reflects on the week while preparing us for re-entry.

Many thanks to the artists whose work helps create a space for our whole beings to come in to. Thanks to Carmen Kelly for the gorgeous conference logo and art, Nhatt Nichols for the cartooning, Natalia Zukerman for sharing her music as part of the Opening Ceremony, Joe and Briar Seamons for getting us singing and dancing during happy hour, Tomia MacQueen for leading us through dancing from the heart during the Closing Ceremony, and Victoria Marie and Haley Brickner from Indigenous Lotus for getting our conference days started with yoga.

It feels potent to me that we're gathering the week of Imbolic – halfway between winter and spring. For those of us in the Northern Hemisphere, the Earth is turning towards warmer, longer days. We're gathering seeds and making plans for planting. Throughout this conference week I invite you to think about what you're gathering while you're here, what you're planning for. What will you learn, who will you meet that will influence your spring? I can't wait to see what we co-create together.

With love and gratefulness,

Cathleen McCluskey

Organic Seed Alliance

Outreach Director and Conference Chair

Black Seed Stories

Bonnetta Adeeb, STEAM Onward & Ujamaa Cooperative Farming Alliance

Gordon Reed, Farms to Grow

Melony Edwards, Organic Seed Alliance

Michael Carter, Jr., Carter Brother Seeds & Carter Farms

Ira Wallace, Southern Exposure Seed Exchange & Ujamaa Cooperative Farming Alliance

Black people in the U.S. have a fraught relationship with farming. This uneasiness and anxiety are born of the deep wounds inflicted by generations of enslavement, followed by decades of white supremacist terror, economic and social marginalization, and official oppression sponsored by a succession of governments dedicated to preventing Black people from building wealth on the land. Yet throughout the centuries, enough Black folk have held fast to culture and tradition to keep alive the seeds of our ancestors. Today, new generations of Black farmers and seed keepers are reclaiming our rightful place in the American agriculture landscape, and heritage seeds are playing a vital role. This special panel will feature Black seed stewards whose personal seed stories reflect the history of Black farming in the U.S. in all its staggering complexities.

Protecting Seed's Diversity: Corn Class Action vs Transnationals in Mexico

Ana Ruiz Díaz, Independent Advisor, Demanda Colectiva Maíz

In July of 2013 a guild of 53 corn producers, scientists, artists, and activists of 20 seeds, farmers, human rights, and environmental organizations, sued Syngenta, Dow, PHI-México (DuPont), Monsanto, and the Agriculture and Environment Secretariats of the Mexican government; this process has lasted over eight years. The plaintiffs call ourselves la Colectividad del Maíz.

The main argument of the class action is to protect human right to corn's biodiversity, based on the precautionary principle. Three months later the courts granted an injunction that banned government to give permits to sow GM corn all over Mexico.

In regard to the trial, according to the rules of procedure in Mexican courts, the judge may, at any time, re-analyze the elements of a lawsuit, and dismiss any of them, in this case defendant's requests to dismiss the claim have been denied. Seventeen Courts ruled in favor to allow the class action to proceed, and prohibited sowing GM corn during the trial.

During 2017 both parties presented evidence. The transnationals filed documents of self-funded research -some translations were altered- and the "Nobel prize letter." Colectividad filed four independent scientific studies proving transference of GM DNA into native varieties of corn, potential consequences if GM corn is planted in Mexico, and five official reports that demonstrate the irreversible damage of corn's transgenic contamination -done by the National Institute of Ecology, the National Biodiversity Commission, the Council of the Ministry of Ecology, the Agriculture, Food Sanitation, Safety and Quality National Service, and the International Agency for Research on Cancer done for the WHO. The Court denied our request to have impartial specialists to examine the evidence and to attend the hearings.

One major accomplishment during the trial is that Mexican judges ordered a Precautionary Measure which, in effect, has banned permits to sow GM corn since September 2013.

On October of 2021, the Supreme Court ruled that judges in a class action lawsuit can dictate any injunction to protect the rights of a collective, and ratified the Precautionary Measure that bans permits to commercially sow GM corn in Mexico. Both were challenged in amparos filed by the transnationals Bayer-Monsanto, Syngenta, Pioneer-Dupont, and Dow Agrosciences since 2017.

Despite winning several battles the trial is not over and we need support from consumers and advocates in the USA, Canada and Europe. We urge you to inform industrial corn producers, and your governments to become responsible for damage that GM corn's monoculture causes abroad and in their own countries to health and biodiversity. Small farmers feed 70% to Mexican poorest families, because they count with diverse corn varieties that are grown in small plots with hundred edible weeds.

Why Seed Companies Fear México

Ernesto Hernández-López, Chapman University Fowler School of Law

This article was originally published by Inter Press Service: News Agency (Rome, Italy) on Nov. 18, 2021, available at https://www.ipsnews.net/2021/11/seed-companies-fear-mexico/

Last month México's Supreme Court provided hope for biodiversity, especially in the Global South, while flaming fear for seed companies. In a historic step, it ruled for corn advocates and against genetically modified (GMO) corn. The decision was a momentous act in country where maíz (corn) carries daily and sacred significance.

This promises a way out of stale GMO debates that plague us. One side argues that genetic changes to seeds increase harvests. Seed companies and industrial agriculture make up this side. Another side says GMOs damage plant DNA. Small-scale farmers and environmentalists stand on this side. Neither addresses the other. This standstill keeps GMO policies ineffective. The court's decision offers a path out of this by cutting at seed company positions. We should follow slow grown Mexican resistance to GMOs.

By emphasizing biodiversity, the ruling fuels sustainable farming worldwide. In legal terms, the decision found that it is constitutional for courts to block commercial permits for GMO corn. Seed companies, like Monsanto, Syngenta, Dow, and PHI, need these to sell seeds in México. They lost.

But much more is at stake than permits and court orders. These agrochemical companies pursue a global push for GMO agriculture, not just in México. Farmers worldwide worry that companies control GMO seed use (not growers) and that seeds cause permanent environmental harm. Frustrations persistently spread, evident at this year's UN COP26 and UN global food summit.

Luckily law and science are on the side of anti-GMO advocates. Because of this, México offers an example of effective legal resistance. The court stated that biodiversity is needed to allow corn plants to grow, mix genes, and adapt, as done for centuries. In other words, biodiversity is necessary for corn as a plant species to survive. GMOs permanently hurt this. The fear is that wind carries pollen from genetically modified plants to mix with non-GMO corn, called *maíz nativo*. Even if unintentional, this can't be undone and threatens corn's genetic variety. GMOs threaten biodiversity, required for plants to adapt to drought, climate change, and varied soil conditions.

GMO proponents paint this reasoning as unscientific and emotional. They are wrong. They prejudge one country's democratic and scientific process used to support sustainable farming.

This debate is not new. GMOs have lost in Mexican courts for years. In 2013, the Colectividad del Maíz, representing farmers, indigenous communities, environmentalists, and scientists, sued in court to halt government review of permit requests. They argued that there were unauthorized releases of GMO genes surpassing levels permitted by México's biosecurity law. Their central claims were that genetically modified plants mix with maíz nativo. This risks permanent damage to México's over fifty maíz nativo varieties. Eight years ago, a trial court sided with the

Colectividad. Last month, the Supreme Court unanimously agreed, after giving the Colectividad and seed companies since 2017 to make their case.

The court explained that the Precautionary Principle authorizes GMO controls to protect biodiversity. With this international law principle, governments prohibit technologies if their safety is scientifically uncertain. Think of it as way for governments to address risks in environmental, public health, or biosecurity predicaments. Employing it, México blocks seed permits as a precaution to curtail GMO damage. This is explicitly permitted in México's biosecurity law, passed with agrochemical industry backing in 2005. Precautionary measures are similarly supported by international laws on GMOs (2003), biodiversity (1993), and the environment (1992). In fact, Global South countries insisted that the Cartagena Protocol on Biosafety explicitly include Precautionary Principle provisions.

GMO interests discount these laws to evade biosecurity measures. They deflect and tout innovation. Insisting GMOs are safe, seed companies refute environmental impacts. Deny, deny, deny, does not work.

GMO proponents flout science. Colectividad lawyers explain that seed companies preferred to not submit scientific evidence on GMO safety. This was an unforced litigation error, signaling larger problems. Observers label company justifications as fake science, because they show that GMO controls on farms fail. For decades, multilateral organizations and scientific studies show how GMOs threaten corn. Moreover, there is no scientific consensus on GMO safety. Put simply, GMOs damage plant genes. Scientists say that they hurt the environment and are harmful to eat.

The power of México's ruling goes way beyond permits. It emboldens national plans to phase-out GMO corn and glyphosate, not just seeds, by 2024. So far, GMO voices stick to losing playbooks, saying this plan is not based on science. Controversies over toxic glyphosate raise more alarm. GMO farming needs this chemical herbicide. A UN agency and American courts found it to be carcinogenic. This has resulted in court ordered payouts, creating a headache for Bayer that acquired glyphosate's producer Monsanto.

All of this inspires sustainable farming globally. Hundreds of countries have agreed to treaties with Precautionary Principle provisions. The principle was central to crafting Mexican biosecurity measures. It can guide more governments to implement effective GMO, biodiversity, and environmental policies. Seed companies agonize thinking if more courts, regulators, or legislatures copy México.

In short, sustainable farmers, environmentalists, lawyers, and most importantly policymakers across the globe should follow México's example. Evident in the Colectividad's determination, resistance is the seed to sustainable success, when it combines legal, cultural, and political efforts.

Seed companies should learn that there are bigger losses than unrealized seed sales. In the long term, markets for popular legitimacy and trust from governments are far larger than demand for myopic tales on science and laws. Discussing corn, free trade ideologue David Ricardo explained the law of diminishing returns, when business choices become counterproductive. This should inspire seed makers to stop opposing precaution.

Ernesto Hernández-López, is a Professor of Law at the Fowler School of Law, Chapman University (California, United States) who writes about international law and food law. @ProfeErnesto1

A Snapshot of State of Organic Seed, 2022

Kiki Hubbard, Organic Seed Alliance

Jared Zystro, Organic Seed Alliance

Liza Wood, University of California - Davis

State of Organic Seed (SOS) is an ongoing project to monitor organic seed systems in the U.S. 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. The 2022 report is our third update, allowing us to compare new data with 2011 and 2016 findings. These data comparisons provide a reliable snapshot of progress (or lack of progress) 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 an essential component to furthering the principles underpinning the organic movement. We are proud to share our 2022 findings.

The SOS project is guided by the following objectives to expand 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, seed industry, food industry, extension, 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 and advocate for a stronger organic seed regulation to increase usage of certified organic seed to 100% 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 associated with seed.
- Address barriers to organic agriculture and the seed market faced by Black, Indigenous, Asian American, Latinx, Multi-Racial, Queer, Trans, and Intersex 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.

The report's findings are drawn from seven data sets: four different surveys, each for 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 Farmers Research Foundation.

Our findings show that organic seed sourcing in vegetable, field, forage, and cover crops remains stagnant. Specifically for vegetable seed, much like we saw in our last report, the biggest producers still use relatively little, and this has a big impact on overall acres planted to organic seed.

We found that farmers 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. This finding is in line with our last report and demonstrates understanding among farmers that breeding crops in organic systems is important to their success and that of the broader organic industry.

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 - 2010, and saw this increase to $22 million between 2011 - 2016. Our most recent finding demonstrates good progress toward funding this critical area of plant breeding and research to support organic seed systems and the organic growers who rely on them. Still, public investments toward organic seed systems fall short in light of growing demand for organic products.

Fewer farmers report saving seed for either on-farm use or to sell commercially compared to our last report. However, 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.

Seed is the fundamental starting point of most food. In this way it represents the perfect entry point for furthering the values underpinning the organic movement: fairness, care, health, and diversity.

There are several ways to accelerate organic plant breeding and other organic seed research and to galvanize more support. Through surveys, interviews, and other assessments described in this report, our data points to the following recommendations for advancing organic seed systems from the perspective of research, funding, and organic seed policy.

- Public research investments should continue to grow and help diversify the seed research agenda.
- A research priority should be filling data gaps regarding regional readiness for closing the organic seed loophole.
- Organic researchers should use participatory models and engagement with Black, Indigenous, and growers of color.
- Researchers should be sure to collaborate with seed stakeholders to align priorities and develop meaningful research outcomes.
- Programs and funding opportunities should expand to target the needs of small seed producers.
- Regulations around the National Organic Program’s organic seed sourcing requirement should be strengthened.
- Encourage swift action on developing a USDA task force to collect baseline data on detectable levels of GE presence in organic and conventional, untreated seed.

- The NOSB should develop recommended guidance on GE testing for certifying agencies and the organic industry.
- The National Plant Germplasm System should be adequately funded to ensure that access to germplasm collections increases for the benefit of the public good.
- The organic seed community, including universities, should support alternative modes of intellectual property protections.
- Resources to develop regional supply chains of organic seed should be directed to regions outside the West to support a resilient seed producer network.

Democratizing Crop Variety Trialing through Community Science

Jay Bost, GoFarm Hawai'i

This session will bring together a panel of folks involved in community/citizen science projects that engage farmers and gardeners to help screen established and in development crop varieties. By engaging with growers, project organizers are able to screen varieties/lines in more environments, in larger numbers, and with fewer resources than possible otherwise. Such projects also serve to engage and educate growers and gardeners. While these types of projects appear to be win-win situations they are not without complications. Participants will discuss joys and pains and share practices and tools they have found effective in making such worthy projects most likely to succeed.

Community Science ADAPT Program

Steffen Mirsky, Seed Savers Exchange

Seed Savers Exchange maintains a collection of over 20,000 open-pollinated varieties in its seed bank. In 2011, we created the Community Science ADAPT Program to help us document and evaluate the collection. As a grassroots, membership-based organization, we have a large network of passionate and knowledgeable seed savers and gardening enthusiasts who are interested in growing unique, rare varieties in community with others for a common purpose.

From the beginning, the goals of the ADAPT program have been to engage the gardening public; to crowdsource information on the performance of the varieties in the collection; and encourage more people to grow heirloom varieties. Starting in 2019, when we adopted the SeedLinked platform to help manage the trials, we redefined the core focus of the program - to help us determine which varieties from the collection to introduce into our catalog, a process we call the "Collection to Catalog Stream."

Since partnering with SeedLinked in 2019, the Community Science Program has blossomed. Participation has roughly quadrupled to include about 270 growers in 2021. The ease of managing the trials has made recruitment a top priority and the new purpose has generated much excitement. Greater participation has been a major accomplishment but it has not come without its challenges.

The ADAPT program includes growers throughout the United States, making it difficult to send out seeds and set deadlines for feedback in a timely manner to everybody's satisfaction. Higher participation has also made it challenging to find varieties from the collection with sufficient inventory and good germination. The greater diversity among participants in recent years has forced us to consider new strategies for communicating, selecting crops to trial, collecting data, and building community in order to be more inclusive and increase the success rate. Higher participation has also meant more time communicating with growers and managing the trials.

The benefits of the program, however, far outweigh the costs. We have a growing community of gardeners who are excited and inspired by the opportunity to grow a curated list of heirlooms and provide input on what gets introduced into our catalog. The program helps raise awareness about the importance of seed saving and crop diversity. It provides a means of assuring that our catalog will continue to provide high quality varieties that will sell and grow well among the general public, and ensures that there is already some familiarity with the varieties when they become available. Crowdsourcing allows us to trial more varieties from the collection and gather more data with far fewer resources.

We’re excited to continue growing and improving the program in partnership with SeedLinked to address these challenges and build on the opportunities.

Community Seed Selection

Chris Smith, Utopian Seed Project

The Utopian Seed Project (TUSP) has been working on a restoration project for Seed Savers Exchange for a few years, with the aim of bringing Whidby White Okra back to a true pale okra pod. The decision to launch TUSP’s first Community Seed Selection (CSS) project in 2021 was largely driven by the surplus nature of seed from the previous year's selection i.e. there was way more seed generated than would ever be able to be planted, and within a year of additional selections that seed would effectively be redundant. TUSP launched the CSS project with two main goals:

1. Further selection goals with a large group of growers
2. Use the project to educate and build community.

The project was listed on our website with a simple sign-up form, and the first challenge was that over 8000 people signed up and only 250 packets of seed were available for distribution. The second challenge was managing the packing and distribution of seeds - TUSP is not a seed company and is light on human resources, making this aspect of the project onerous.

Note: TUSP launched a second CSS project in the fall of 2021 with collards. To address the first two challenges, TUSP partnered with Southern Exposure Seed Exchange to pack and distribute the seeds (this turned the project into a fundraiser and helped filter people who were truly engaged and not just after free seed - see challenge #1).

Until the returned seeds (so far, 58 returned packets out of 250 distributed) are planted out, it will be unclear whether goal #1 has been successful. It was clear early in the project that making objective selection criteria for genetic improvement (i.e. pale / white pods) was challenging when all other variables were completely uncontrolled. Reports of phenotypes were all over the spectrum for plant height, leaf size and production. Despite this concern, the overwhelming success of goal #2 made this project worthwhile on its own.

Community engagement was the major win for a non-profit with an educational mission. A combination of regular eNews, YouTube videos and Facebook Group posts created solid educational materials and an intergroup community support network throughout the season. Participants with a wide range of experience levels shared photos throughout the season, asked questions and gave updates, and there was a lot of inter-community support. As a tool for generating a ‘breeding ecosystem’ that is ready to be adaptive to change then this method of outreach and engagement is very effective.

TUSP's second CSS project with collards is currently live and has a slightly different objective. The shared seeds were a broad composite cross of 21 varieties. There are some defined objectives, but also an emphasis on encouraging people to follow their own path with this collection. It'll be very exciting to follow along and see what new regional varieties come from this mix.

Note: Airtable was used to manage the project, which has been smooth and easy.

A Seed Innovation Platform Powered by Growers.

Nicolas Enjalbert, SeedLinked

SeedLinked is a two-sided platform: a seed innovation platform powered by thousands of grower's reviews that fuel a prescriptive seed marketplace. Everyone can create their own trial and/or organize collaborative trials openly in the platform with minimum supervision. Then having their insights connected with thousand other growers making collective seed intelligence. The platform came out of a dream to use modern technology like mobile phones/apps, cloud computing, and data science to create a better seed system by being: 1) Simple to use with the best user experience (UI/UX) for growers; 2) Collaborative across all stakeholders in the seed system; 3) Accurately generates seed knowledge for all stakeholders to make the best decisions with confidence; 4) Connected to avoid siloed data between projects, organizations, and regions, thus providing maximum value in exchanging seed knowledge; 5) Diverse, with a framework that allows collaborative trials across all crops, breeding stage, region, management, and people; 6) Democratic and transparent, available to all while displaying the full story of each variety; 7.) Ethical, with genuine governance and a strong core mission; and 8) Financially sustainable, innovative in its business model. That might be ambitious. But as President Sirleaf said. "If your dreams do not scare you, they're not big enough."

Since its launch in 2019, SeedLinked has facilitated more than 350 collaborative trials across 35 crops, with more than 4,000 expert growers across most North America, generating more than 100K reviews across 1,500 varieties. In 2019, more than 80% of users rated the SeedLinked platform as very hard to use. In 2021, 78% of users rated SeedLinked as easy to very easy to use. Thanks to amazing organizations like Seed Savers Exchange, Seed to Kitchen Collaborative, Farm Folk City Folk and UBC, we worked directly with growers to solicit their feedback to improve our trialing software one step at a time. We have demonstrated the high accuracy of our data across most crops. Participation rates in trials have gone up between 45-80% for our partner organizations, as compared with using pen and paper data collection.

At SeedLinked, simplicity remains our biggest hurdle and the "ultimate sophistication". In a highly diverse movement, the challenge becomes enormous to satisfy all use cases without compromising ease of use. Also, as user numbers are growing rapidly in North America and Europe having stable, reliable, bug-free tools has been challenging. Finally, as our partners start to have many more growers in their trials, new logistical and communication problems have arisen.

SeedLinked had to evolve and find novel solutions. As an example, we are adding a social Feed to the platform as well as a notifications framework to help with trial communication, and support growers in creating online communities of practice around trials. All this evolution requires SeedLinked to have a bigger team and new skills. The question remains: how do we finance a transparent trialing and seed finding platform? We not only have to innovate on how we crowdsource and share data but now we must innovate in the business model. As part of our innovation, we are proud to announce launching a data-driven Marketplace this month with many amazing seed company partners.

In conclusion, to fully democratize variety trialing and variety decision making for all, with a specific eye on enabling and growing organic and local seed systems, we believe it must follow a bottom-up approach where growers are at the center and where insight and added value flow both from and to the growers to create adoption of new varieties and exponential collective insight for all.

Hawaii's Citizen Gardeners: Island Connection through Seed Selection

Tyler Levine, SEEDS of Honua

Marielle Hampton & Glenn Teves, UH Cooperative Extension Service

In early 2021, the Hawaii-based online workshop series "Save Seeds, Save our Future" shared seed saving knowledge and skills with gardeners of all ages as part of a partnership between University of Hawaii's Cooperative Extension Service and the youth-led organization SEEDS of Honua. After the series ended, our project team was faced with a new challenge: how can we maintain the momentum and community built through this virtual education program? With inspiration from breeder Jim Myers of OSU and a breeding partnership with Glenn Teves, a new citizen science project connected gardeners across the Hawaiian Islands to grow and make selections from pigeon pea varieties and F2 tomato seeds of a Hawaii grape tomato, Komohana, crossed with the purple and green-when-ripe 'Indigo Kiwi'. Over a six month period, participants grew out their plants, collected data, saved seeds from selected plants, and shared seeds with their community. Guided by the project team, Hawaii gardeners had an opportunity to engage in the plant selection process and begin the exciting journey of developing new varieties, as well as learning to better grow these crops.

As a first foray into citizen science, the team kept the goals of the project simple: introduce Hawaii gardeners to the process of breeding and selection, build excitement and skills around seed saving in the community, and grow out interesting seeds beyond individual or institutional capacity. The project launched with a recruitment campaign shared primarily through partner email lists including Hawaii Seed Growers Network, Master Gardeners with UH Cooperative Extension Service, school garden networks, and the SEEDS of Honua organization. With only a flyer and a Google form, the project quickly reached over 80 sign-ups. To narrow the participant list down to active and engaged individuals, the first online group meeting was mandatory in order to receive seeds. After the first gathering, tomato and pigeon pea seeds were mailed out to attendees, with a follow-up email detailing how to prepare their garden for seed saving.

To facilitate the project, monthly Zoom meetings helped build community and offer support. The project team included extension agents, seed growers, and educators, bringing crucial gardening and seed saving expertise to participants through group meetings and tailored resources. If questions came up during the meeting, a facilitator would take notes and add the questions and answers to our running Q&A document. Participants were also encouraged to add their questions to the document before each meeting so we had a chance to review what we should cover during the session. We also conducted a live tomato seed saving demonstration where participants were encouraged to practice their wet seed processing skills along with the group. For future projects, the team plans to record the monthly meetings so participants can revisit the content or view the session if they weren't able to attend. Another important online tool was a website called Padlet where participants could post photos of their plants each month. This created a visual display that kept participants engaged and excited about the project while providing a snapshot of the group's progress at a glance.

We used a simple post-program survey to learn which project elements were the most helpful and determine how participants planned to use what they learned. Most participants intended to save more seeds in their garden and show or teach others about the seed saving process. The responses also indicated that Zoom breakout rooms were often perceived as less helpful than other activities like the live demonstration and Padlet. Feedback from the comments showed that the virtual platform was effective and enjoyable, especially for those in remote communities across Hawaii.

As with any new project, we've learned valuable lessons about facilitating successful experiences for participants as we navigated online tools, varied skill levels, and attendance attrition. By sharing insight about the project structure and challenges, we hope our experience can help guide future programs with similar goals, sharing the science and art of seed breeding with the community.

Culinary Breeding Network: Engaging the Public in Variety Selection and Development

Lane Selman, Oregon State University/Culinary Breeding Network

The Culinary Breeding Network (CBN) is an initiative that strives to improve communication between plant breeders, seed growers, farmers, chefs, produce buyers and other stakeholders engaged in developing and identifying varieties and traits of culinary excellence for vegetables and grains. Ten years since its inception, CBN has a mission to bridge the gap between plant breeders and eaters by creating unique opportunities for stakeholders to see and taste in-development vegetable and grain cultivars. Everyone in the local food system can share their opinions and be a participant in variety assessment and development. Through these events and gatherings, plant breeders gain valuable input that would normally be inaccessible. Inviting chefs, farmers, everyday eaters, and other end-users into the breeding process gives breeders insight into preferred traits and the chance to identify standout material while simultaneously increasing public awareness and understanding of organic plant breeding.

While CBN has been successful in reaching its goal during in-person events, Covid has created a challenge for maintaining a high level of community involvement. Several remote tastings were organized in different manners in order to evaluate for flavor and consumer acceptance.

Consumer tastings for a Dry-Farm Tomato Project were led by CBN and conducted at the Dry Farming Field Day (Corvallis), outdoor Dry-Farm Tomato Fest (Portland), and 47th Avenue

Farm's CSA pick-up (Portland). For the Field Day and Tomato Fest, three sets of tomatoes were made available for people to taste, organized by market class/color. In each tasting set, fruit from 3-6 varieties was prepared the same way as for the research crew (i.e. washed, dried, and quartered). Samples were placed in labeled plastic bags, and samples for each complete tasting set were placed in paper bags along with a QR code for an online survey (Qualtrics). Varieties were once again coded with letter/number combinations to disguise variety identities. Samples were presented in random order, and tasters were asked to rate texture and appearance on 1-7 hedonic scale with 1=do not like and 7=like a lot. Tasters were also asked to describe each sample using a provided list of descriptors.

For the Northern Organic Vegetable Improvement Collaborative (NOVIC) project, chef tastings were conducted by CBN including evaluation of winter squash and shishtio peppers. Samples were prepared and dropped off to participating chefs. Samples were placed in labeled paper bags with a QR code for an online survey Seedlinked. Consumers were recruited via social media, CSA membership, and through the CBN mailing list.

Democratizing Crop Variety Trialing through Community Science

Kristyn Leach, Second Generation Seeds/Seed Stewards

Second Generation Seeds aspires to honor our lineages by offering high quality, organically grown, open-pollinated varieties that are invaluable to the people who love them. Through our collaborations with growers, breeders, chefs, and community organizations, we work to identify and develop desirable traits for Asian crops, in hopes of imbuing them with relevance for the future. Through online and in-person experiences, we aim to widen our circle of dialogue about all the elements needed to pass on old stories, and imagine new ones. We want to design new forms of participatory research that excite and empower our communities.

Grower's Collaborative

We work with growers around the country to share, multiply, and adapt seed stocks to various climates. We are working on creating online tools to facilitate a decentralized seed bank, where preservation means actively growing and continually improving.

Seed Stewards

We work in tandem with community organizations, chefs and food advocates to work on a season long seed preservation project. We help support internal community building to identify, remember and deepen our relationships to heritage crops and cultural foodways. Through our Seed Stewards online network and in-person events, we share tools, resources, and space for

our seed stewards to learn every aspect of growing a crop from seed sowing to seed cleaning. Community partners facilitate storytelling sessions to help us collectively remember the place these crops have had in our histories, while chefs and food advocates energize the conversation by creating culinary iterations steeped in tradition.

Perspectives on Organic Vegetable Legumes: Current Status and Breeding for the Future

Hayley Park, Oregon State University
Rebecca McGee, USDA – Agricultural Research Service
Michael Mazourek, Cornell University
Linda Fenstermaker, Osborne Quality Seeds
James Myers, Oregon State University

Introduction

This panel seeks to highlight current work in breeding organic vegetable legumes and initiate a discussion about current and future varietal needs, while tying the discussion to a larger stakeholder needs assessment. Previously, crops such as snap beans and garden peas have received only minor attention, being combined with the field crop forms of these species. Traits of importance for organic production are potentially different between field and vegetable crops.

To explore these demands further, our panelists will expand on personal topics of expertise, including bush and pole snap beans, snap and shelling peas, pea shoots and sprouts, as well as industry trends in a variety of vegetable legumes. James Myers, Vegetable Breeder at Oregon State University, will present on bush-habit snap beans with a discussion of valuable traits for both organic beans intended for the fresh market and processing market. Michael Mazourek, Vegetable Breeder at Cornell University, will discuss the value of pole beans on diversified, organic vegetable farms and his collaborative work to develop 10 multi-use pole bean cultivars intended for use on such farms. Additionally, he will discuss his ongoing work to incorporate colorful flavonoids into snap peas. Rebecca McGee, Research Geneticist at the USDA-ARS station in Pullman, will discuss breeding objectives for a variety of pea crops including shelling types, shoot and sprout types, and field peas. Linda Fenstermaker, West Coast Sales Representative from Osborne Quality Seeds, will be presenting on trends in legume seeds in the organic farm industry.

Snap beans (bush-habit)

Snap beans are the vegetable cousin to dry beans and share the same basic biology. There are differences; nutritionally, snap beans have lower protein and carbohydrates but possess certain vitamins that dry beans lack. Snap beans share common origins with dry beans, and research problems overlap, but many aspects of snap bean breeding and genetics related to their use as a vegetable are unique to the crop. Among others, they have been selected for low fiber, stringlessness, and thick, succulent pods. Yield for snap beans is more complex than for dry beans because of the need to balance yield with quality.

Snap beans fall into two main types: Those used for processing and those grown for fresh market. The two types have different requirements – for example pod fiber levels can be much higher in fresh market types compared to processing types. Processing types have additional requirements such as round pod cross-sections, white seed, and concentrated pod set. Much of the breeding effort for the crop has been on disease resistance (viruses, anthracnose, rust, bacterial brown spot, common bacterial blight, halo blight, white mold, root rots). Additional research has been focused on quality traits (pod color, fiber, texture, etc.), taste, flavor, and human nutrition (sugars, calcium, flavor volatiles and phenolics). Some research activities have concentrated on improving plant architecture and yield for processing varieties, but this type of work has not been carried out for fresh market snap beans.

Snap beans are valuable in crop rotation on organic farms because they are a legume and can potentially add nitrogen to the soil. However, the needs of organic growers have not been assessed to determine whether contemporary cultivars are well adapted, and what traits might be incorporated that would be useful to organic growers, markets, and consumers. One trait of value to organic production that is not necessarily important to conventional production is that of biological nitrogen fixation. In conventional agriculture, snap beans are managed as if they do not have the ability to fix their own nitrogen, mainly because the crop rapidly reaches harvest maturity before the symbiotic process has time to establish and contribute nitrogen in any quantity to plant growth. The situation is somewhat alarming because we are beginning to see snap bean cultivars bred in fertilizer-intensive conventional production systems that completely lack the ability to form nodules and fix atmospheric nitrogen. Breeding for snap beans that establish symbioses early and rapidly fix nitrogen could be an objective of breeding for organic production.

Are there other traits that would enhance organic production? This is where input from the organic community is needed to establish the goals of breeding snap beans for organic systems.

Snap beans (vining-habit)

Pole beans can be a better fit than bush beans for diversified farms. While bush beans are self-supporting, their short stature, concentrated pod set, and maturity are ideal for mechanized harvest. Pole beans are ergonomic for hand harvest, are easy to work into crop rotations with single plantings instead of succession plantings, and continue producing when harvests are missed or skipped. Pole beans also break the cycles of disease that accumulate when growing the same crop every summer or every other summer. As a nitrogen fixing legume, they reduce the need for fertilizer and therefore salt buildup in the high tunnel soil. This has the potential to extend the duration a high tunnel can stay in production without being moved or having the plastic removed for rain to wash out accumulated salts.

With the welcoming support of Zaid and Haifa Kurdieh at Norwich Meadows Farm, and cross-pollination pairings by John Hart (now Earthworks Seeds) we began a collaborative breeding project. Seed multiplication was integrated into the production farm by reviewing the crop before the first harvest to make selections. A couple pods on each selected plant were labeled with red mesh sleeve bags to allow market harvest to happen while we saved seed. We developed ten new pole bean cultivars for multiple uses as snap, fresh shelling, and dry bean use. We were guided with harvest trait input from the growers on the farm, flavor critiques from Zaid and Haifa, and lab genotyping that confirmed seed transmitted virus resistance.

Peas (snap/edible pods)

As we domesticate plants from the wild, they become more practical to grow but lose their resistances and phytochemistry. The peas we grow tend to have Mendel's white flowers to avoid bitterness and astringency of the associated flavonoids in wildtype, purple flowered plants. We are exploring the benefits for plant and person of restoring colorful flavonoids to peas.

Peas (shelling, sprouts, shoots, and field)

Peas, *Pisum sativum*, are grown and consumed either as a vegetable or as a dry, pulse crop. Vegetable peas have traditionally been consumed as immature seeds, either canned, frozen, or fresh and are frequently referred to as garden peas, shelling peas, or English peas. In the 1970's edible pod peas, ones in which the pod as well as seeds are consumed, became popular. In recent years, pea sprouts and shoots have become a third vegetable pea product. English peas typically have dark green, wrinkled seeds, and white flowers (all Mendelian traits). Breeding efforts have focused on resistance to biotic stress (primarily aphid vectored virus diseases, foliar fungal pathogens, soil-borne pathogens), end-product quality (flavor, texture, color, appearance) and, of course, yield. As with most legumes, English peas can form a symbiotic relationship with Rhizobium and fix atmospheric nitrogen, much of which is left for subsequent crops.

For organic production, some issues of concern include pea seed weevil, fast germination and stand establishment, and maturity timing. Pea shoots and sprouts are relatively new. Sprouting peas are typically Maple peas and are usually grown in controlled conditions. Sprouting peas have long internodes, pigmented flowers, and normal leaves. They are typically consumed as a vegetable or garnish when they are about 15 cm tall. Pea shoots are also used as a garnish or vegetable and are grown either in fields or controlled conditions. In this class, the leaflets have been converted to tendrils with a leaflet on the end of each tendril. Breeding objectives for both pea shoots and sprouts include rapid germination, flavor, and texture.

Field peas are considered a pulse crop as they are harvested when the seed is physiologically mature. They have either green or yellow cotyledons, white flowers, and are typically semi-leafless. They are sold as either a whole food, dry (e.g., split peas) or re-hydrated and canned (e.g., mushy peas), or are further processed and used as an ingredient. There is growing interest in plant-based proteins and field peas are a crop of choice because they are high protein (25%), have no allergen issues, and are non-GMO. Breeding efforts have focused on resistance to biotic and abiotic stresses, nutritional quality (protein and mineral concentrations), and processing attributes.

Input is sought on additional agronomic and quality traits that are important to organic growers of English peas, pea sprouts and shoots, and field peas.

Industry perspective

Linda Fenstermaker, West Coast Sales Representative from Osborne Quality Seeds, will be presenting trends in legume seeds in the organic farm industry. Through her experience working with organic farmers and as an organic farmer herself, she will describe popular varieties of beans and peas, as well as general consumer trends in these crops. A few areas of focus include colorful peas, common beans, and fava beans. She will also identify areas of growth for increased organic seed use within the industry.

Needs Assessment

We hope you'll join us for a meaningful conversation among our panelists and the audience, as we seek to define the path forward for breeding work on a suite of vegetable legume crops. A needs assessment will be available during the conference via Qualtrics (see QR code), where we encourage those of you who work with any vegetable legumes to lend your voice to the discussion as well.

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Seed is Liberation

Edwin Baffour, Food Sovereignty Ghana

Frances Davies, Zambia Alliance for Agroecology and Biodiversity

Justin Sardo, A Growing Culture

Ramón Vera Herrera, GRAIN

In order to reclaim our rights and agency lost to corporate consolidation, we all need to be invested in the movement to reclaim seed. That movement currently hinges on its capacity to confront policies and treaties that marginalize and criminalize seed saving around the world. Chief among them is the Union for the Protection of New Plant Varieties (UPOV), a treaty responsible for stripping seeds from the hands of farmers and turning over control to corporate breeders. Confronting UPOV legally has proved extraordinarily difficult, given the ways in which it's embedded within powerful institutions like the World Trade Organization (WTO). Ultimately, returning seeds to their rightful place — within communities — will require a mass movement. To catalyze that movement, we need to tell a new story about seed — one that recognizes the power in community autonomy through seed sovereignty, and that understands the corporate control of biodiversity as part of a long history of extraction from the Global South. This panel is an opportunity to share the ways in which our collective struggles, hopes, and liberation, are connected through seed and through resistance to UPOV.

Small- to Medium-Scale Seed Cleaning Equipment: How to Make the Best of What You Have and Know What You Need

Beth Rasgorshek, Canyon Bounty Farm

David Catzel, FarmFolk CityFolk

Louisa Brouwer, Ferry Boat Seeds

Anaka Mines, Twisp River Seed

Mark Luterra, Luterra Enterprises LLC

Knowing which pieces of equipment will be most useful, scale appropriate, affordable, and provide the most return on your time and investment can be challenging. This session will include information on a range of seed cleaning equipment options including DIY and repurposed, must-have and favorite machines, and shared equipment options. Join a panel of farmers to hear directly from them what pieces of equipment they use, recommend, and dream about for their seed crops.

UPOV and the Criminalization of Seed

Indra Shekhar Singh, Independent Agri-Policy Analyst

Justin Sardo, A Growing Culture

Silvia Rodriguez, Costa Rica's Biodiversity Coordination Network

The Union for the Protection of New Plant Varieties (UPOV) is a symbol of corporate efforts to consolidate control of seed saving around the world. Understanding UPOV begins with the history of legal rights to seeds — from seed as collective commons to seed as privatized commodity through intellectual property rights (IPR). This panel will explore the different forms of seed IPR, from patents to plant variety protection, and how UPOV blurs the line between the two. It will cover UPOV's evolution from UPOV 61 to UPOV 78 to UPOV 91, and how each iteration has steadily eroded farmers' right to seed. It will delve into UPOV's enforcement through the World Trade Organization (WTO) and Trade-Related Aspects of Intellectual Property Rights (TRIPS), and its dire implications for communities around the world. Panelists will provide insight into some of the legal struggles against UPOV that communities have mounted in order to maintain sovereignty over their biodiversity. By understanding where those movements have succeeded and where they've faltered, we can chart a path towards a more just seed future.

The Heirloom Collard Project: A Model for Collaborative Seed Work

Bonnetta Adeeb, STEAM Onward & Ujamaa Cooperative Farming Alliance

Chris Smith, The Utopian Seed Project

Ira Wallace, Southern Exposure Seed Exchange & Ujamaa Cooperative Farming Alliance

Melissa DeSa, Working Food

Kristin Eggen, Seed Savers Exchange

This panel discussion will showcase the evolution of The Heirloom Collard Project as a learning case study for inter-organizational collaborations that can sustain themselves over time. This project has shown the strength of collaboration in many ways, but has also overcome challenges that come from working together. The result is a project that is greater than the sum of its parts, and we're proud to share some of that journey and the lessons learned along the way. What does it take to create a community? Why is collaboration important? What are the challenges and rewards of working together towards a common goal? Join this panel of collard loving community seed activists and leaders to discuss the project and be inspired to start your own.

Ira Wallace, Southern Exposure Seed Exchange

John Morgan and Edward Davis collected and described many collard landrace varieties in their book *Collards: A Southern Tradition from Seed to Table*. One thing that Morgan and Davis noticed is that these stewards were all old, some really old and many did not have a family member to carry on the seed saving tradition. Mark Farnham at the Charleston, SC USDA Agricultural Experiment Station grew many of the varieties and has beautiful pictures as testimony to the uniqueness and diversity of this collection. Southern Exposure Seed Exchange (SESE) and Seed Savers Exchange (SSE) began working together to learn more of the story that goes with these varieties, and to look for seed stewards from SSE members and other active seed savers for the Morgan and Davis collard collection. As the project continued Chris Smith founder of the The Utopian Seed Project (TUSP) and Melissa DeSa of Working Food (WF) joined the core group of stewards and supporters of The Heirloom Collard Project.

The Heirloom Collard Project has a place for everyone: home gardeners, farmers, cooks, chefs, and eaters; groups such as Master Gardeners, Southern Foodways Alliance, Slow Foods USA; seed companies, heritage sites and organizations, and the community of Southern chefs and restaurants wanting to promote and celebrate heirloom collards and the people who preserve them. Lorraine Mortis (Alpha Kappa Alpha Sorority Sister) and Elmer Kessee (Master Gardener) are Black seed savers who took on stewardship of the William Alexander Heading Collards. The seeds they grew and saved for the Heirloom Collard Project became the first verified African American stewarded seeds added to the Svalbard Global Seed bank in Norway.

Seeds samples of 60 heirloom landrace collards from the USDA collection have been planted for evaluation and seed increase at the Seed Savers Exchange Heritage Farm. The seeds have also been grown by a few experienced and new seedsavers. As the seeds become more available, more gardeners and farmers will be able to grow and steward these varieties. The first training on collard seed saving and taking oral histories for new stewards took place in 2016 at the Heritage

Harvest Festival at Monticello. Since then, many groups and publications like the Heirloom Gardener and Mother Earth News are sharing the story of these varieties with readers. Chefs, like Michael Twitty and Asheligh Shanti, are eager to try these varieties. More recently in 2021 Lane Selman of the Culinary Breeding network in 2020 added Collard Week to their Winter Vegetable Sagra. The goal is to build a strong community of "self-sustaining" heirloom seed stewards. Seed Savers Exchange, Southern Exposure Seed Exchange, Working Food, The Utopian Seed Project, Ujamaa Collective Farming Cooperative and a growing list of individuals are committed to this project. You are invited to join us!

Melissa DeSa, Working Food

The Heirloom Collard Project (HCP) began life officially in 2016, with the launch of a website highlighting the Morgan and Davis collard collection. However, it took a hiatus for a couple of years with challenges in staff turnover in key organizations. In 2020 the project was revitalized, when Norah Hummel at Seed Savers Exchange started making some phone calls and emails, after discovering this incredible project with so much potential was lying dormant. The Heirloom Collard Project was re-born, and collected some additional organization support!

In 2020 the HCP organized a national variety trial accessible to all gardeners across the country, to learn more about, and share the wonder of 20 unique varieties. The trial was run through the SeedLinked platform and participants received 3 randomly selected varieties. The 2020 trial quickly became a full-on community science project with results coming in from all regions that included 52 farmers and 192 gardeners.

In addition, 8 sites grew all 20 varieties including 1) Comfort Farms in Milledgeville, Georgia, 2) University of Florida in Gainesville, Florida; 3) Franny's Farm in Leicester, North Carolina; 4) Ebony by Nature in Enumclaw, Washington; 5) Mudbone Grown in Corbett, Oregon; 6) Oregon State University in Aurora, Oregon; 7) Organic Seed Alliance in Chimacum, Washington; and 8) Southern Exposure Seed Exchange in Mineral, Virginia.

Jon Jackson of Comfort Farms in Milledgeville, GA, an incredible Black veteran farmer, was one of the full trial site farmers. New to seed saving, but very interested in crop diversity, culture, history, and heirlooms, he was a natural fit and brought great perspective and energy to the project, while also learning about collards and seed saving practices. He ended up successfully saving one of his favorites, Old Timey Blue, and is proudly growing them this season!

One of the full trial sites was at the University of Florida's Field & Fork teaching farm in Gainesville, Florida. Students enrolled in hands-on educational courses experienced a real-world scientific variety trial, following the helpful guide provided by Organic Seed Alliance. The teaching farm was opened up to public visitation 5 days a week, and also hosted 2 field days for gardeners, farmers, and chefs who came to sample the greens and give their feedback. Most people, even farmers, had no idea so many collard varieties existed! Participants enjoyed leaving with armloads of greens, and the farm donated over 1,000 lbs to the food pantry on campus.

A collaboration with Lane Selman, director of The Culinary Breeding Network (CBN) in Portland, Oregon led to "Collard Week" in December of 2020. This was part of CBN's Winter

Vegetable Sagra, which had shifted to an online platform in response to the pandemic. The HCP fitted perfectly with CBN's aim to celebrate eating local and seasonal vegetables. The event was accessible to anyone with the internet and a computer. Michael Twitty launched Collard Week with over 1,000 views of this live streaming event on the first day! Today the video sits at over 2,000 views. The rest of Collard Week was incredible, with great speakers and content! Lane referred to it as a Collard Love Fest. Truly, everyone who spoke during the events, and the core organizers behind the scenes are deeply in love with this vegetable, its history, and its future.

The HCP was a really fun and exciting way to stay connected, and form new connections, during such a challenging time. People absolutely loved participating in the trials, and the feedback was overwhelmingly positive.

Chris Smith, The Utopian Seed Project

The ongoing work of the highly collaborative project has led to an exciting and dynamic project that has had a rapid impact and reach. There is genuine excitement for the work that is being done, with positive feedback from social platforms and media reach. The HCP engages its community on a range of platforms including: a dedicated website; Instagram; a Facebook Group, and video content via the Culinary Breeding Network. A broad group of community partners and engaged participants amplify the message of the HCP. Part of the successful message has been a focus on celebration, while not forgetting the important history and culture of collards in the south. The HCP is also focused on building community through engagement and education.

The work of the 2020 collard trials and Collard Week led to national media attention, with multiple articles including one by Deb Freeman in Atlas Obscura, and mentions in the Modern Farmer and FoodTank. HCP representatives were interviewed on radio with Evan Kleiman of Good Food, and with Margaret Roach of Away to Garden.

Despite the success of 2020 and the media attention and growing following, the HCP remained a loose affiliation of collaborators with no sustainable funding. The work was achieved through the passion and volunteer time of the core collaborators. The HCP realized the power of this grassroots and authentic project, while also recognizing the need for structure and funding.

Kristin Eggen, Seed Savers Exchange

After the trials and Collard Week energy died down, follow up discussions with the HCP organizing team led to the big question: "What's next?!" With so many ways this project could go, and so many additional voices that could or should be at the table, a meeting of the minds for a visioning session was in order.

Seed Savers Exchange has been a key leader in this entire project, and came through with a timely grant from 1772 Foundation that funded an in-person meeting at Franny's Farm, Leicester NC. Farmers, seed keepers, storytellers, scientists, writers, professors, community organizers, seed companies, and even a fashion designer came together to answer the question, "What's next?". Trained in the art of graphic harvesting and meeting facilitation, Kristin Eggen facilitated a thoughtful day that was inspiring, empowering, and had some pretty great conversations.

Key takeaways from the visioning include:

- New and renewed interest in specific projects, and project leadership
- Valuable community discussions around equity, diversity, and seed stories
- Relationship building amongst partners and participants
- It can be hard to maintain momentum across multi-year collaborative projects!
- Articulated values of the project
- A start on crafting a visions statement for the project
- Direction to move the project forward through three key focus areas:
    - celebrating collard history
    - promoting collards in the kitchen
    - growing heirloom collards.

Bonnetta Adeeb, Ujamaa Cooperative Farming Alliance

Bonnetta Adeeb got involved with the Heirloom Collard Project through one of my fellow commissioners at Cooperative Gardens Commissions. Steam Onward started a Seedhub serving the DMV shortly after the Covid shutdown. YRCP afterschool youth at Steam Onward Inc. built out an entrepreneurial program that could possibly fund their STEM work in the region. Planning on setting up an online store selling seeds, starts and native fruit trees, all institutions were shut down. Fortunately for us the store was converted to a free seed donation site and the college youth developed a Tiller Corp to help families, churches and pantries grow fresh food. It happened that the requested seeds for our community were not being donated by the major heirloom companies.

Enter stage left the Heirloom Collard Project. Bonnetta was asked if she had six friends who would be interested in collards and everyone she asked gave a resounding yes! It turned out these mostly retired teachers and educators grew up with gardens managed by parents or grandparents but had never started gardens themselves. There were stories of beautiful bounty and of regret at this lost heritage. Particularly because most of these African American women were suffering from disease that were largely diet related. High blood pressure, diabetes, cancer, lupus and other conditions could be treated by improvements to their diets.

Everyone interviewed had a connection to collards and to a healthier lifestyle. Seeds shipped to everyone came in the mail and 3 varieties each were planted. Unfortunately, Bonnetta’s seeds never arrived in the mail. She believes someone realized that those collard seeds were a treasure and got them before she did. The most challenging part of the trial had to do with the difficulty some had in using SeedLinked to track the trial data.

Bonnetta’s growers report stories of “pot liquor” being stashed away by Momma because it had the best parts down in the button of the pot”. When Bonnetta’s family relocated to California, they, like many families, continued to have greens daily. After a while all of the adults moved to drinking green water daily. This is like raw pot liquor she believes. In the future Bonnetta hopes to study the benefits of these dark leafy greens to the overall health of our people.

Many growers wanted to know what greens were eaten in Africa by their ancestors that collards were able to replace in the culture. We will be learning for many years to come. Ujamaa Farms will in the future research “Food as medicine?” and challenge people to ask more questions and eat more home-grown food.

Lessons for the Organic Seed Movement from International Perspectives

Mauricio Bellon, Arizona State University

Abena Offeh-Gyimah, Living The Ancestral Way

Daniel Tobin, University of Vermont

Fenzi Marianna, Swiss Federal Institute of Technology Lausanne

Jay Bost, GoFarm Hawaii

The organic seed movement in North America has grown tremendously in the past decades. What started out as a relatively small endeavor, based on rejecting the tenets of the Green Revolution, and focused largely on seeking out and preserving heirloom varieties, has now become a diverse, modestly large part of the North American seed sector. Due to the explosion of organic agriculture itself, organic seed is no longer focused on heirloom varieties (though this strand still exists and is flourishing) but is now also served by both private (independent and multi-national) and public breeding programs.

The dualistic view of heirlooms vs F1 hybrids of the past continues to blur, as the organic seed movement matures, and more nuanced views and approaches have evolved with the growth of modern heirlooms, modern landraces, improved OPs and organic hybrids; and 'dehybridization' and 'breeding population' entering into the vocabulary of increasing numbers of growers.

The organic seed sector is now populated by what can roughly be seen as two camps of seed purveyors. First, an ever-increasing number of small to medium independent regional seed companies and projects, focused upon regionally adapted seed with interesting culinary and/or historical/cultural meaning (non-commodity traits). These companies and projects tend to produce their own seed and/or source seed from a network of diversified farms that include seed as part of their agricultural system. Second, there are larger companies that act as dealers for seed and seed varieties supplied by large international breeding and seed production companies who focus on agronomic performance and disease resistance. Seed from these companies tends to be grown by seed growers specialized in seed production, rather than diversified producers.

While the above division among seed suppliers is not always clear cut, it does exist and is indicative of an underlying tension of approaches in Organic agriculture itself: large, input-substitution, wholesale-oriented vs small to medium, more agroecological influenced, regionally oriented farms. Large organic farms focused on national wholesale markets share much in common with them in the design of their systems (including being less diversified) and their market orientation. Seed production and/or seed saving tends to be uncommon on such farms, instead outsourced to "expert" suppliers who provide ever improved germplasm. Agroecologically-influenced producers tend to be smaller, more local and regional in market orientation and more diversified. Seed production for sale and/or for on-farm use is more common on such farms, but still not as widely practiced as it could be.

The larger, input substitution style farms can rely to a certain degree on the research and models developed by conventional agricultural systems (with some obvious tweaks) and there is little focus on non-commodity traits or cultural memory in such productivity focused systems which like their conventional neighbors operate within the narrative of profitability. On the other hand, medium and small, more diversified growers have by-in-large rejected the models and systems of conventional agriculture and until recently have been underserved by the Land Grant system and the USDA, though happily this is changing (to some extent). These growers have more in common with practitioners of "traditional agriculture" elsewhere in the world, particularly in the global south, and have looked to systems and models in "less developed" agricultural systems for inspiration, along with engaging in copious amounts of experimentation and trial and error.

Here we would like to share the perspectives of four researchers who have worked in various parts of the global south, as well as in Europe, but are also, to differing degrees, familiar with agricultural systems in North America. These researchers have inspiring examples of farmers proving to be adaptable, savvy, and nimble - creating crop varieties and agricultural systems that both serve their newer economic needs and allow them to maintain traditional practices and on-farm crop evolution. It is hoped that these will be inspiring stories for North American organic farmers, navigating related challenges of creating and sustaining diversity and non-commodity traits in the context of neoliberal economic systems which include structural biases against doing such.

Mauricio Bellon, Arizona State University

The seed (including planting material for vegetatively-propagated crops) is the most important input for agriculture; without it, agricultural production cannot take place. Seeds are not only an input for, but also an output of agricultural systems since seeds have to be produced and then used to generate crop production. However, seed is more than an input or an output. Research on seeds and seed systems in developing countries has shown that seeds embody important environmental, social, and cultural values for farmers and consumers, and depend on social structures to exist, evolve, and diffuse.

For smallholder farmers in developing countries and particularly for their native crops, a crop plays multiple functions or roles in their livelihoods, such as a source of food, income, cultural identity, social status and as part of a safety net. Seeds contain the traits that underpin these multiple functions. Given the multi-functionality of crops, it is not possible to ascribe a value to their seeds just based on a simple notion of yield, e.g., bushels/acre, but to how well the seeds deliver the traits that farmers and consumers want. Many of these traits, however, have no market value and therefore no price, creating a dilemma for farmers who have to balance the market and nonmarket values of the seeds they need and want.

Clearly, the conditions, motivations, and resources of smallholder farmers in the rural areas of developing countries are very different from commercial farmers in the USA. However, there are important insights that can be gained from the study of the seed systems of the former, particularly for organic farmers and seed producers that have multiple considerations in their agricultural decision-making beyond profit maximization.

Seeds have both private and public characteristics and values: (a) private, those characteristics that cannot be consumed by, or values that cannot accrue to, two farm households at the same time, e.g. grain, fodder and other traits produced in each farm household's crop; (b) public characteristics, those related to the seed genetic attributes that are available, and benefits that can accrue, to all those that have access to a particular type of seed, including its contribution to genetic diversity. While the private characteristics of the seed usually occur at the household or enterprise level, the public ones can occur at different scales from local (a community) to global (the world).

The different ways farmers obtain seed through time and space in a particular place and context constitute a seed system. A seed system includes a set of: (1) transactions that define how seed is obtained such as sale, barter, gift, loan, etc.; (2) social relations that define from whom seed is obtained and that can include family, friends, strangers, commercial agents; (3) information and knowledge about the identity, origin, traits, performance, and variability of the seed; (4) social rules that define who can get seed and under what circumstances; (5) social structures that enforce those rules; and (6) practices that define how the seed is stored, selected and transported. These six aspects describe and characterize a seed system in a particular location and context. Seed systems are social constructs that link the seed as a biological entity to social structures and processes. This link has important biological and genetic consequences.

While there are many seed systems around the world, we can distinguish conceptually two broad types: traditional (or informal) and modern (or formal) seed systems. They have contrasting characteristics, dynamics, and implications for agricultural and food systems. Historically, traditional seed systems have been the norm, being in the hands of farmers and communities. Traditional seed systems are: (1) open, seeds can come in and out of the system, farmers incorporate, keep, discard and share seeds; (2) decentralized, farmers and communities make different and independent decisions in multiple locations, environments and situations about what seeds to plant, keep and share; and (3) local, the spatial scope of the system can be quite local, i.e. farmers usually obtain seeds from the vicinity of where they farm (short distance seed flows), but sometime they can also get seeds from faraway places (long distance seed flows). Traditional seed systems are usually governed by cultural norms—reciprocity, fairness—e.g., seed should not be sold, or only “good” farmers can get seed—and they are based on family ties and local social networks. However, they can include village markets, strangers, and interactions with formal seed systems. These systems are not static or conservative since they include experimentation and allow innovation, which is part of their openness, and foster crop diversity and crop evolution. In traditional seed systems the private and public characteristics and benefits of seeds are closely linked and reinforce each other.

Modern seed systems are a recent creation, mostly appearing around the middle of the last century. These systems are in the hands of plant breeders and seed companies. They are driven by profits, specialization, and economies of scale, and are based on commercial transactions and homogenized products. They are closed by design since they are based on a constrained and regulated entrance and removal of seeds, imposing, and enforcing special characteristics associated with seeds that produce plants that should be distinct, uniform, and stable (DUS) and with tight Intellectual Property Rights regulation and enforcement systems. There is a strong focus on the private characteristics of seed (particularly high yields) which is central to generating profits (i.e., discourage saving and sharing of seed among farmers). They are centralized since relatively few actors (seed enterprises) make decisions in a few locations, environments and conditions about the seeds and their characteristics. These systems are increasingly becoming global, at least for certain crops since the spatial reach of a few seed enterprises is global. In modern seed systems the public and private characteristics and benefits of seed become de-linked. While seeds produced by modern seed systems generate high productivity (private benefit), they rely on past accumulated genetic variation—conserved in gene banks—and tend to create homogeneity over space and time. They may have limited capacity to adapt to change due to their high centralization and homogeneity and may reach just a limited number of farmers and farming systems.

Informal seed systems are better at supplying seed with non-market traits since they do not depend on profitability to function. While formal seed systems are better at supplying seed with market traits and depend on profitability. Organic producers in the USA are commercially oriented, they depend on formal seed systems. However, to the extent that they or their clients also value nonmarket traits in their production, one can imagine that there is a need for some type of informal seed system. Therefore, there is a need for both types of seed systems in organic agriculture. This requires the creation of mechanisms that foster their coexistence and links between them and recognize their different strengths and weaknesses. This means the development of new markets, breeding strategies and exchange mechanisms for seed in organic systems that fosters this coexistence. A lesson from smallholder maize farmers in Mexico is the process known as "creolization" in which farmers adopt scientifically bred commercial varieties but grow them together with their native varieties under the same management, including saving and selecting seed for replanting. Through this process they generate varieties that combine the benefits from scientific breeding with the desirable traits from their local varieties. A similar approach is that of evolutionary breeding, in which breeders generate diverse crop populations with desirable characteristics that are then taken by farmers who select seed from them according to their needs and preferences, including those of their clients. This approach may be particularly useful for crops grown on a small scale but by numerous farmers under different conditions.

Daniel Tobin, University of Vermont

As has been outlined, seed systems are often conceptualized as a binary: informal or traditional systems and formal or modern seed systems. Useful as it to conceptually organize seed systems into categories, they do not typically exist in isolation in reality. As traditional and modern systems have converged in local places, the expectations of full homogenization by the formal seed system (lauded by advocates of modern agriculture and feared by its critics) have not been fully realized. Through several examples in both the Global South and Global North, I demonstrate how farmers navigate the convergence of the modern with the traditional, developing strategies that often engage both systems.

In Peru, strategies reflective of modern agriculture have been implemented to improve persistent poverty and nutrition insecurity among smallholders. In 2008, PepsiCo – owner of Frito Lay's – began purchasing three native potato varieties with colored flesh that could be successfully fried into potato chips from producer organizations in the central highlands. Farmers planted the potato varieties for PepsiCo in their fields closest to home, where they typically grow crops for market, while reserving their more distant fields at higher altitude to plant potato varieties that they preferred for home consumption, managing them using traditional practices.

Recent research among maize farmers in Chiapas, Mexico has revealed even closer interaction between the modern and traditional. Within both indigenous and mestizo communities, our preliminary findings indicate that farmers managed field plots of landraces and criollos differently from hybrids. However, regardless of seed type, some management practices were applied including using traditional tools, using manual labor, and applying synthetic herbicides, suggesting that farmers use some traditional management practices and techniques on hybrid seeds and vice versa.

As compared to the Global South, the interaction between modern and traditional in the Global North typically operates in reverse fashion, where efforts are proliferating to introduce or revitalize traditional practices into situations where modern agriculture and formal seed systems have dominated. In Vermont, seed growers, including those who sell seed commercially, have indicated that they have myriad reasons for producing seeds of diverse cultivars, including economic pursuits but also non-market reasons, suggesting that like in the Global South, farmers and gardeners in the Global North do not feel it necessary to choose between modern or traditional agriculture (see Isbell et al., 2021 for a full discussion).

This series of case studies intends to depict how farmers across geographic and social contexts blend the modern with the traditional instead of choosing between one or the other. Relatively small units – farmers, households, communities – are nimble and make decisions about how to incorporate aspects of each based on what makes sense to them. Far more complexity is present when considering if and how to manage the process of the mixing of these two systems. Critical questions of power and governance - the process by which decisions are made and enforced - emerge. To date, these interactions have been governed by an unrestrained modern agriculture framework, which views traditional agriculture and informal seed systems as impediments needing transformation. This is a moment that the US organic seed system gets to decide how to approach the convergence. Whatever the outcome, the mixing of modern and traditional systems will occur. It already is - and so the question becomes how.

Marianna Fenzi, Swiss Federal Institute of Technology Lausanne

The Green Revolution has been presented by the modernizers themselves, and often by social scientists, as a homogenizing force, due to the spread of its innovations and to their expected global impact. These innovations were supposed to win out systematically over other possible alternatives (e.g., hybrid maize in opposition to local varieties). Without denying their impact, it is also important to highlight further explanations of the continuities and re-organization of the agro-rural landscape and bring to light other narratives. Taking inspiration from Dipesh Chakrabarty's idea of "provincializing Europe," I would like to move beyond the epic narrative of agricultural modernization. I will take care not to reproduce a narrative of agricultural modernization as a universal and homogeneous process, whether positive or harmful. To provincialize is to re-examine representations about the triumph or disaster of agricultural modernization, and to reject any attempt to reduce Mexican or European farmers to a single role as "the dominated." This means, for example, uncovering instead the motivations behind their choices. In this presentation I will describe two examples of farmers' management of maize diversity in Mexico and in Europe (France and Italy).

To rethink the supposedly homogenizing imaginary of the Green Revolution, we need to take into account the real impact of particular innovations within agroecosystems. According to the estimation provided by the International Maize and Wheat Improvement Center (CIMMYT), between 60 and 80 percent of the area under maize cultivation in Mexico is still planted with seeds from saved seed lots and farmer selection (including landraces, mixtures, and advanced generations of hybrids). Many scholars have highlighted how peasant agriculture, combined with the failure of the centralized breeding model, has been a central factor in the conservation and evolution of the diversity of Mexican varieties (Kato et al. 2009; Perales 2016; Bellon et al. 2018).

To show how local seed systems remain the fundamental source of maize seeds in Mexico, my first example highlights the influence of both soil quality and community-level conservation of crop diversity in a farming community in the Yucatan over a ten-year period (Fenzi et al.2017). Moreover, I show the dynamics of seed diversity in this community, which experienced an unusually high level of precipitation in spring 2012. Farmers were able to recover and restore the community's usual diversity of cultivars in the year following this critical climate event (Fenzi et al. 2021). Rather than defining the negative impact of certain innovations from the Green Revolution, these studies aim to unveil the difficulties encountered in their application, and ultimately aim to highlight the evolution of local maize diversity, which extends far beyond modernist categories such as "primitive" and "modern" varieties.

The second example is from France and Italy, where agrobiodiversity can also be an opportunity for farmers. Currently, the available organic seed and plant breeding material cover only around half of potential demand for seed for organic agriculture. The EU's Farm to Fork Strategy is promoting a goal of 25% of farming area under organic cultivation by 2025, compared to about 8% today. Landraces will play an important role in organic agriculture, by addressing growing demands for organic seeds. Although European contexts differ from those in Mexico, there too farmers share efforts to retrieve lost diversity and to create new meanings for seeds. Even in Europe, seeds are not just biological material: they result from farmers' practices, choices and attachments. The practices surrounding them can vary greatly between groups for historical and pragmatic reasons, and these examples highlight how seeds can be a vector for new values and common projects among farmers. In the homogenous varietal context of Europe, the adoption of heterogenous varieties has made important contributions to the development of diversified agricultural systems and new forms of socialization among farmers (Fenzi & Couix 2021).

In conclusion, this presentation will emphasize that "provincializing" is not only about uncovering anomalies or "resistances" that escape the capitalist frame, but also about identifying the everyday multiplicity of farmers' efforts, values, and visions.

Abena Offeh-Gyimah

In June 2021, a farmer called Baba Kumase in the Upper East region of Ghana wrapped white sorghum and pearl millet seeds in brown paper bags, handed them to me, and asked me to share and save the seeds. He mentioned that these seeds have been cultivated in his community for the past 70 years. He pointed out that, in recent years, many farmers have shifted away from growing indigenous crops towards genetically modified sorghum, corn, and soybean.

Many rural farmers in West Africa have always had access to a variety of indigenous seeds they shared and traded through informal seed systems. These networks included neighboring farmers, community gatherings, markets, and events leading up to the planting season, and their own harvest.

Rural farmers trust the seeds from their informal seed system. They know these seeds will rarely cost them, they can confidently grow them without chemicals, and they have access to the person or community they received the seeds from.

When we started our seed saving group, Back to the Roots, in Bolgatanga, Ghana, we were informed to connect with older women farmers to get access to organic indigenous seeds. We were told the women can name the varieties of seeds by heart, which ones grow well in different soil, and which seeds did well in what areas of their community. Furthermore, we were informed that the women can distinguish between different varieties that might look similar, which ones are best for particular dishes, which grains should be preserved for the dry season, which varieties are used in ancestral ceremonies, which ones do well when the rain is too much or too little, and so on.

The knowledge of the seed, and the holder of the seed, is almost always an elder, and most likely the same person.

The informal seed networks are the system that farmers use to feed their families and communities. With their local organic seeds, they can trust to grow their own food, save the seeds, own it, share it, distribute it, save some, and repeat again. They trust the seed to show up for them every year. When rural farmers share seeds within their informal networks, they are ensuring that each community is food secure, that there is diversity among local seeds, and variety continues to exist within the indigenous crops.

Some communities have seed custodians, like Mr. Fuseini, in the Nabdam district in the Upper East Region. He has been farming organic foods for 30 years, and his practice of using agroecology has increased the resilience and quality of the seeds he saves. Even as a seed custodian, the seeds do not end with him. The seeds are distributed among many across and outside the community, recently, he gave me a few seeds to save and start planting myself. These are seeds I would never otherwise have access to, definitely not in any formal seed system. I had to be in the village to get access. I did not even know that West Africa had its own indigenous pumpkin and potato plants, so I took those seeds.

In our first seed saving workshop, when rural farmers talked about seeds, they talked about their parents who were farmers, they talked about how other seeds were connected to the birth, or the passing of someone in the community, they talked about which animals ate what plants, and how the late millet grows very well in one community but in another community an hour away, the late millet did not grow quite well. In all this, they were talking about biodiversity, sustainability, ecosystems, community, and wellbeing.

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Building Your Seed Brand: Cultivating the World We Dream of While Growing a Sustainable Business

Daniel Brisebois, Ferme Coopérative Tourne-Sol

Erica Kempter, Nature & Nurture Seeds

Mike Levine, Nature & Nurture Seeds

Petra Page-Mann, Fruition Seeds

How do we cultivate the world we dream of, while growing a sustainable business?

We believe, simultaneously, that a) sharing seeds is more important than ever as well as that b) Audre Lorde nailed it:

"The master's tools will never dismantle the master's house."

As fraught as it is, as seed companies we are committed to both sharing exceptional seed as well as continually creating more capacity for mutual flourishing, in this and all generations to come, as the seeds we so love are constantly modeling.

As a panel, we approach 'marketing' and 'branding' as so much more than font choice, tech tools and advertising. Sharing our strategies and lessons learned as well as aspirations, we aim to develop our individual and collective capacity to tell stories and build skills as well as cultural imagination.

We believe relationships root us in a caring, abundant and accountable community. How do we cultivate such relationships with seeds, with ourselves, with each other and with our world, as seed companies? Building from the centering of healthy human relationships, we'll explore what we've learned in both in-person and online contexts.

The tools we use (email, social media, websites & so much more) are opportunities to build, heal and re-imagine what it means to be in relationship in a culture of care.

We bring to this conversation just the kernel of our individual and organizational learnings --- we have so much more to learn! --- and if you'd love to explore these worlds more intentionally with us, don't be shy.

Bees As Seeds: The Importance of Place, Power, & Purpose in Seed Production and Pollination Conservation

Melanie Kirby, Institute of American Indian Arts Extension

Teresa Quintana, Institute of American Indian Arts Extension

Paul Quintana, Institute of American Indian Arts Extension

Over the river and through the woods, seeds' stories are passed down from one generation onto the next. Many of these genetic stories are part of a cyclical choreography between flowers and pollinators. Just as importantly as nurturing naturally resilient and adaptive seeds, so it is for nurturing naturally resilient pollinators. The Bees as Seeds Experience is a story within a story, reflecting our fascination of plant seeds with those of bees, whose own stories manifest season after season and which are also passed down from one generation onto the next. The passage of time coupled with landscape and elemental influences help to sculpt these stories for both plant seeds and pollinators. This presentation will share an overview of the diversity of pollinators with a focus on the often exploited poster child of pollinators, the small but mighty honey bee. Also included in this presentation is an introduction to the Institute of American Indian Arts' ancestral seed projects and pollinator programs in recognition of the importance of place, power (responsibility), and purpose as forms of reciprocity nurturing stories for our descendants who also serve as future ancestors. For within itself, every seed has a story, formed over millennia- with the power to nurture and adapt; and the magnificence to create life, food, and medicine for the world.

A Seed Policy Roadmap for the Pacific Northwest

Kiki Hubbard, Organic Seed Alliance

Amy Wong, Oregon Organic Coalition

Seed, a universal symbol of hope and nourishment, represents the cycle of life for most agricultural crops. As a fundamental input in agriculture, seed serves as a farmer's first defense against pest, disease, and other production challenges. Seed genetics also largely dictate the quality and integrity of our food — from appearance to flavor to nutritional content. In this way, seed holds endless potential for transforming how we farm and what we eat, especially when coupled with the foundational tenets of the organic movement — health, ecology, fairness, and mindful stewardship of the land.

The Pacific Northwest (PNW) has the potential to be a leader in organic and non-GMO vegetable seed production due to the region's ideal climate and environmental conditions. Organic seed production is also urgently needed to support the growing demand for organic food, now a $56 billion industry. When rooted in agroecology and fairness, organic production can serve as an impactful solution to daunting problems, such as climate change, market consolidation, and pesticides in our environment.

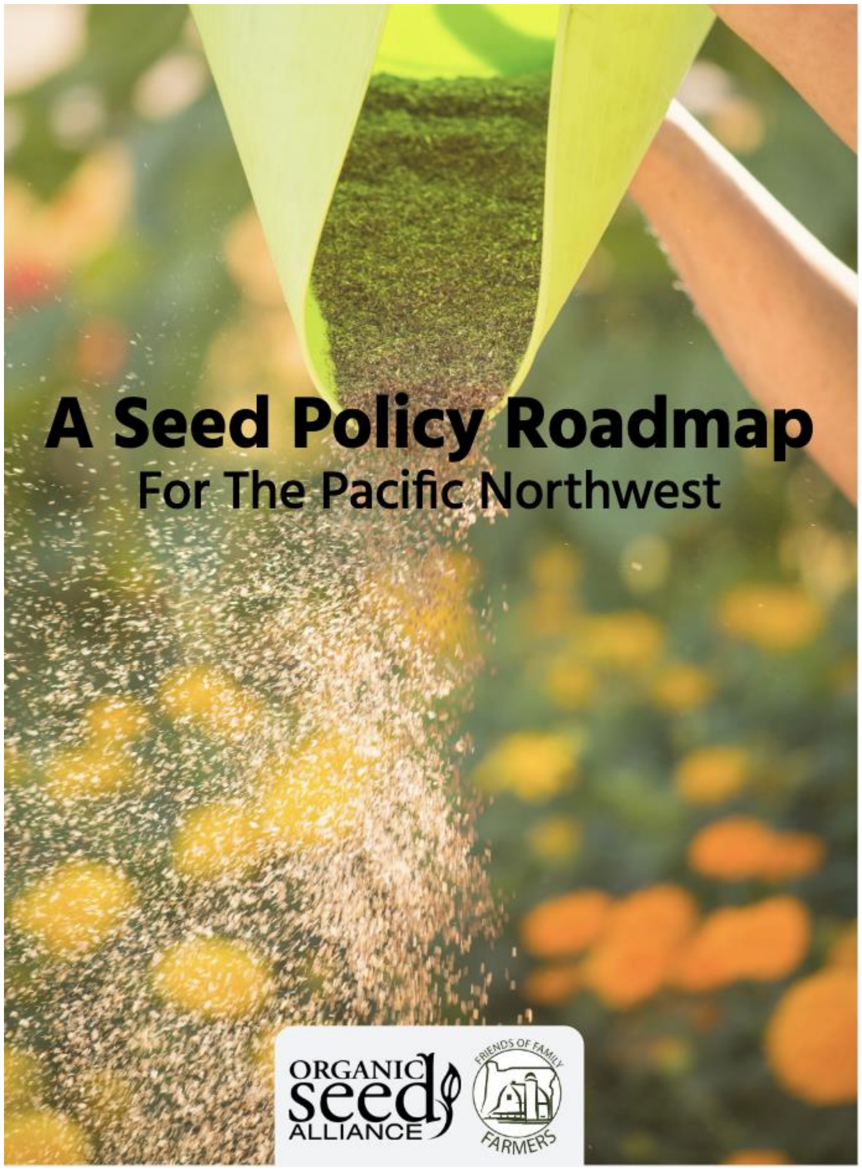
The COVID-19 pandemic highlighted critical fractures in conventional agriculture supply chains. Now, more than ever, policy makers should make investments in resilient regional food systems. Because the PNW faces a series of cascading climate and other extreme weather events, it is critical that the region prioritize food security. Organic and non-GMO seed production in the PNW should be a cornerstone of regional food security efforts. However, additional resources and protections for organic and non-GMO seed growers are needed, as is strengthened education and outreach to better influence regional legislative and regulatory policy in light of inadequate federal regulations.

This Roadmap was developed by Organic Seed Alliance and Friends of Family Farmers with input from additional regional stakeholders. The Roadmap lays out 1) why this work is important, 2) an overview of regional seed advocacy already underway, 3) suggested policy approaches for moving forward, and 4) a toolkit of resources for seed policy advocates.

Included in the Roadmap is an interactive map of important seed policy initiatives across the U.S. There are several ways that seed advocates can help execute this roadmap and policy platform. Here are three ideas:

- Share this strategy roadmap and policy platform with food and farming organizations in your city and state, especially groups that actively engage in state policy making.
- Join an existing membership organization in the Pacific Northwest that is already involved in seed policy. (See Appendix A in the Roadmap for a list of PNW organizations that support organic/non-GMO seed.)
- Share this strategy roadmap and policy platform with politicians who represent you in your county and state. Set up a meeting to discuss your concerns as a grower or consumer and ask what it would take to get their support. Share outcomes from these meetings with allies, including the organizations referenced above.

It is imperative that seed advocates and stewards engage in advocacy to advance shared policy priorities to ensure that this living, natural resource is managed respectfully, shared appropriately, and protected for future generations. Organic Seed Alliance hopes this roadmap will serve as a starting place to help advocates identify where they can make an impact and where they themselves are impacted by current policies and procedures.



Running a Small Online Seed Company from Growing to Managing Inventory to Packing to Shipping

Daniel Brisebois, Ferme Coopérative Tourne-Sol and the Farmer Spreadsheet Academy

Reiley Ney, Snake River Seed Cooperative

Reiley Ney, Snake River Seed Cooperative

Inventory management has many complex issues for small scale seed companies. As your inventory grows, the problems you run into change and grow as well. We have found that the tidier and more organized our inventory data can be, the fewer mistakes we make and the more time we have for building relationships with our growers and our customers.

At Snake River Seed Cooperative, we previously used Google Sheets for managing our crop data. This worked okay for us, but we constantly had to take turns using the main spreadsheet with inventory information. As our business grew and we added more coworkers, this caused challenges because more people needed to access the inventory spreadsheet daily. We also needed to see different columns for our various roles, so the spreadsheet organization would change often as different coworkers would hide columns to tailor it for their purpose that day.

The solution to these problems for us has been migrating our data and spreadsheets to the platform Coda.io. Coda takes spreadsheets to another level by allowing different views of the same spreadsheet. This means every coworker is able to organize the table with their own view for their specific needs. There are also many different formats for the table, such as detail view for those of us who do not enjoy looking at lines on spreadsheets, several calendar views, and many different chart views. There are options to group rows together, sort by columns, add conditional formatting, and filter by columns. You can also apply formulas to columns, similar to other spreadsheets.

In the past year, we have transitioned to using Coda for nearly all of our operations. We use Coda for assigning crops to 40+ growers, for seed lot intake information such as weights and germination test results, for tracking variety availability, for grower payments and grower surveys, for operations, and for collecting seed crop production information from our growers so they can reference each other’s growing tips easily. Whew, I know that was a long list, so to sum it up, the most impactful ways we use coda are for inventory and seed production management.

At the link below, you will find a “Playground” document that is full of examples of how we use Coda. We call it a playground because you can interact and play with the document! You are welcome to make a copy of the document and edit it as you please. If you do not want to make a copy, feel free to explore the main document by clicking buttons, checking boxes, etc., but please return the document to its original state before leaving the webpage by clicking “undo” as many times as needed. To click “undo”, please move your cursor over the top left corner and click on the three dots.

https://coda.io/@reiley-ney/snake-river-seed-cooperatives-inventory-management-playground

Coda is an affordable resource that is easy-to-use and customizable for every seed company. Just in the past year, Coda has saved us many hours of labor, which is major for any small business.

During this presentation, I will share my screen and show examples of how we set up our inventory and seed production management at the Playground in Coda. Please feel free to email me with questions.

In Seedy Solidarity!

Reiley

Dan Brisebois, Ferme Coopérative Tourne-Sol and the Farmer Spreadsheet Academy

Do you knock your head against a wall trying to keep track of all that seed you have in your seed company's storage room?

You can do a lot with simple spreadsheets to manage a complex farm-based seed company.

For this panel I've streamlined some of the systems that we use at Tourne-Sol farm to give you an idea of what is possible.

You can make a copy of these Google spreadsheet templates at spreadsheet.farm/2022seedsystems

There are 5 sheets where you can record different types of data:

- **Products Tab:** Add your different products here. Assign a SKU and name to each product. You also set the target seed count per pack.
- **Start Inventory:** A record of the bulk seed you currently have on hand. For each product choose the relevant SKU, record the Lot number and then note the weight.
- **Acquisition**: A list of the seed you plan on getting or growing. It is also where you list what you actually received. For each product choose the relevant SKU and assign a Lot number. You can record the lbs you're planning on getting/growing. You then record when you receive the seeds and how much you actually received.
- **Packed:** Record the seed packs you fill over here. Choose a lot, record the packs you filled and then how much seed you used.
- **Germ Test:** Keep track of any germ tests you have in process

All the information in these sheets is then summarized on the **Dashboard** sheet.

The Dashboard shows you all the seed lots you have in stock, and how much weight is left of each lot. It also displays the germ rates and dates for each lot.

Please note that you can NOT modify the data on the Dashboard. It simply displays data from the previous 5 sheets.

These sheets were built with a number of simple spreadsheets tools and formulas including SUMIFS. INDEX MATCH, Data Validation, and SORT and UNIQUE. There is a tab at the of the template sheet with some resources to better understand the formulas.

Feel free to adapt these sheets to your seed business as you wish. Connect your crop plan and all your other seedy spreadsheets! It's time to get organized.

Seed Production for Market Growers

Kitt Healy, Organic Seed Alliance

Nathaniel Talbot, Deep Harvest Farm

Annie Jesperson, Deep Harvest Farm

Crystal Stewart-Courtens, Cornell Cooperative Extension

Eric Kampe, Ann Arbor Seed Company & Green Things Farm Collective

As demand for regionally-adapted organic seed increases, and more farmers feel the effects of pandemic-era seed shortages, market vegetable growers are becoming increasingly interested in producing seed either for their own use or for sale. While vegetable production and seed production share many complimentary activities, there are unique aspects to seed production that market growers who aspire to grow seed need to consider.

The panelists featured in this session have experience integrating seed production into market farming operations, and balancing the demands of each. Through brief presentations, discussion prompts and questions from session participants, the panelists will explore the following considerations for adding seed production to market farms.

Where to start

The best place to start an experiment in seed production is with crops you already grow to maturity. Fruiting crops (such as peppers and tomatoes) are a good place to start, since the seeds are mature when the fruit is mature, growers are already familiar with the full life cycle of the plant. Producing seed of crops that you love is also important, since a natural curiosity about the plant will pull you through the inevitable challenges of the season. Also, try starting with seeds that do not require additional equipment to harvest or clean. Crops cleaned through a wet process (fleshy-fruit crops) and brassicas are good places to start. Finally, it is a good idea to research which seedborne disease might affect the crops you are interested in. If you really love a crop, but it is very difficult to produce disease free seed of that crop in your region, then you might want to consider starting with something else, or planning for seed treatment (eg. hot water treatment) as part of your management plan. Remember, if a seed company has a hard time finding growers for a particular crop, it may be because producing quality seed of that crop is a challenge. This can either present an opportunity to specialize and orient your systems toward that one crop, or can be a warning to hold off on that crop until you have a bit more experience.

Production practices

Adding seed production to your market vegetable operation has important implications for your farm management plan. Most seed crops are in the field for a significantly longer season than shorter-season successional vegetable crops. This will influence how you do field layout and plan for crop rotation. Isolation is very important for seed crops, especially those grown commercially, and accommodating the isolation requirements for your crop may present a logistical challenge. Depending on the crop, there are some simple tricks and technologies you can consider to minimize crossing between your seed crops and your vegetable crops.

Another management practice you'll have to consider as a market grower exploring seed crops is irrigation. Growers will need to strategize about how to effectively mix drip and overhead irrigation to make sure seed crops are dry when they need to be, and have access to the nutrients they need to set good seed. Greenhouses are another way to control water applications to any crop, but they can be particularly useful for late maturing seed varieties, and to assist with post-harvest ripening. Since greenhouse space is prime real-estate on any farm, it is important to consider the costs and benefits of dedicating some greenhouse space to seed crops, especially later in the season when winter vegetable crops need to be under protective cover, and seed crops need to be dried down.

Workflow and time management

Integrating the workflow of seed production into a market vegetable farm can take time. It is helpful to consider which are your most intensive months for vegetable production, and which are most intense for seed production and seed cleaning, so you can allocate your growing season energy with intention. If you do retail seed sales, fall and winter might also be intense times for marketing and mailing orders. It may take a few seasons to develop systems for how you prioritize the many tasks of growing vegetables and seeds, and to find the time-saving efficiencies where seed and vegetable production overlap. If the timing of a certain seed's maturity, or the processing needs for that crop, interrupt your vegetable production workflow too disruptively, you may need to consider a different seed crop.

Business models

There are a variety of business models that growers can consider when integrating seed production into a market vegetable farm. Whether you plan to grow seed for wholesale contracts with retail seed companies, or sell direct to consumers yourself, experienced growers advise starting small and keeping good records. Starting small gives you the space to learn through trial and error, and to build a good reputation with your seed company customers. Record keeping helps you to understand why you made money or lost money on a certain crop, even at a very small scale. As one experienced seed grower puts it, "if I made money and I don't know why, that's a problem." Most farms already keep detailed records for their vegetable operations, and systems for seed record keeping can be overlaid with those already in place for vegetable production.

Having a vegetable operation alongside your seed business can also provide an opportunity for selling individual plants or fruits culled from your seed-producing population, or selling parts of the plant that you don't need to keep for producing seed (e.g. cabbage heads on stecklings). As an alternative to having seed and vegetable operations married within the same business, some growers have found success in cooperative farming models involving separate seed and vegetable operations that incorporate under one LLC. Even without the formality of a cooperative business arrangement, small scale seed growers may benefit from equipment sharing with other seed growers in their area. If others in your market farmer community are interested in growing a few seed crops, you may be able to share the costs of seed cleaning equipment, drying space, and perhaps collective marketing.

While it can seem intimidating to add seed production to an already busy market vegetable farm season, many growers find a deep satisfaction in stewarding their crops from seed to seed. With planning, record keeping, curiosity and a sense of adventure, this satisfaction can be matched with economic success and diversification for your business and lifestyle.

Systems Based Research Networks

Organizing committee: Michelle Wander, Carmen Ugarte, Martin Bohn, Bryan Endres, Alice Formiga

Edith Lammerts van Bueren

Sara Nawaz and Susanna Klassen

Benjamin Schrager

Introduction

This panel discussion builds on findings from a participatory breeding and testing network focused on corn and soil health that explored constraints on seed quality in the organic seed sector using corn (maize) as a case study. That effort identified many valuable outcomes that organic systems promise to deliver that can be associated with traits used for selection (Endres et al. in review). Development of these traits may help organic agriculture retain and expand its credibility which is increasingly challenged due to fraud and competition. Unfortunately, the cost differential between organic-and conventional non-treated seed, and competition from imports, currently make it difficult to garner investment in desired agronomic, environmental, or grain-quality traits. We wonder whether organic systems could better deliver their promise through systems-based research networks that legitimize the food system using agroecological principles. We look to others for answers and insights into several questions. Can the organic sector successfully operationalize its core values-based principles including ecological integrity, health, fairness, and care through participatory research and breeding networks? Can and should organic certification move beyond GMOs as a proxy for purity? Panelists' answers to compelling questions will help us to refine our ideas about how to best design and deploy seed-soil-societal-systems (S4) research.

Topics of interest

Systems-based-breeding has been proposed as a way to meet sustainability targets (Lammerts van Bueren et al., 2018). This approach combines diverse breeding strategies and technologies to produce seeds that are part of the common good and the basis of agrobiodiversity. It seeks to diversify entrepreneurial approaches, and innovates business structures to increase corporate accountability and full cost accounting. To design processes and institutions needed to support systems-based-breeding, this panel will consider the credibility tests used for scientific legitimization that are used to justify food systems. Montenegro and Illes (2016) encourage agroecologists to build legitimacy for sustainable agriculture by leveraging and reshaping existing standards and practices, expanding political, legal and, social influence, and concentrating on ethical dimensions of food systems. Whether and how organic agriculture can contribute to legitimization of agroecological methods through systems-based breeding will depend upon how organic agriculture adapts to changing technologies, engages in discourse, and maintains or expands credibility. Nawaz et al. (2020) suggest that conversations about the compatibility of gene editing and other emerging technologies with organic principles based on degree of human intervention may be excluding important actors from the deliberation process. Intentional over-simplification of the complex discourse on genetics, and agro-industrial food systems may be a barrier to progress for systems-based breeding efforts. Shah et al. (2021) argue that the presentation of CRISPR-based gene editing as a precise technique used to modify genes conceived of as stable objects is a strategic argument that undermines effective public governance. Strategic framing of issues to garner public support for, or against, technologies can hinder open public dialogue needed to judge societal promises and identify the unintended consequences of their use. Work by Schrager and Suryanata (2017) demonstrates how seed corporations employ marker assisted selection, which enables genetic analysis as opposed to modification, to more quickly conduct seed corn improvement in Hawaiʻi. Through marker assisted selection (MAS), corporations further consolidate their R&D advantage and control over commercially viable seeds. Such technologies present perils and opportunities to the development of organic and participatory crop breeding programs. Further, criticism by Hawaiʻi residents to the large footprint of corporate seed corn nurseries calls attention to the challenge of fostering ethical relations when utilizing winter or year-round nurseries. Answers from our panelists will help us determine what credibility and legitimization processes are needed to achieve systems-based-breeding efforts to create food and farming systems that satisfy organic principles of health, ecology, fairness, and care?

Systems-based Networks - Edith Lammerts van Bueren

The speaker will address how do we design and fund systems-breeding and research networks to realize socially and environmentally resilient agriculture. Are organic breeding methods well positioned to take a lead in these efforts?

Edith has worked in and for the Dutch organic sector for more than 40 years. She has been engaged as senior researcher at the Louis Bolk Institute and since 2005 she has also been a special professor of Organic Plant Breeding at Wageningen University. Edith was co-founder and chairman of the European Consortium for Organic Plant Breeding (ECO-PB), and now leads the BioAcademy, a Dutch platform for education for organic agriculture.

Dilemmas of Gene Editing Technologies - Sara Nawaz and Susanna Klassen

The speakers will discuss how gene-editing technologies are challenging the US and Canadian organic sectors to re-articulate what 'organic' signifies, and in the process, pushing the sector to grapple with several philosophical as well as practical dilemmas.

Sara is a Postdoctoral Fellow at the University of Oxford and University of British Columbia and studies social, ethical, and governance dimensions of emerging environmental and climate technologies. Her past work has focused on agricultural applications of gene editing, gene drives, and synthetic biology. Her current projects are examining ocean-based carbon dioxide removal. Susanna is a PhD Candidate, Public Scholar, Liu Scholar at the Institute for Resources, Environment and Sustainability & Centre for Sustainable Food Systems at the University of British Columbia.

Marker Assisted Selection and Corporate Land Grabs - Ben Schrager

The speaker will analyze the implications of the seed corn industry in Hawaiʻi with an emphasis on the role of Marker Assisted Selection as distinct from GMOs. MAS creates advantages over time but tends to focus narrowly on yield.

Ben is an Assistant Professor in the Dept. of Ag. Economics at Utsunomiya University in Japan.

Panel follow up

A special section in the Journal of Agriculture, Food Systems, and Community Development (JAFSCD) will consider systems-based research efforts in partnership between eOrganic and INFAS, the Interinstitutional Network for Food and Agricultural Systems. JAFSCD has an open-access, community-based publishing model and commitments to equity and food justice. INFAS is committed to: 1) raising visibility of research-based insights into food system problems and solutions, 2) catalyzing frontier work in food systems research, higher education, extension, and institutional change by working together, 3) diversifying who is doing food systems work in academia and in action-focused research, education and extension, and 4) increasing our capacity to help build U.S. food system resilience, sustainability, and equity. Participation in this section addressing systems-based research networks is solicited here, by invitation and through INFAS's Feb 4 online meeting. We are interested in following up on several questions. To design systems-based-breeding and/or standards to endorse food and farming systems, should we focus on technologies or outcomes? What traits or system attributes should participatory S4 networks seek to develop for use as credibility tests for prosocial values? Do organic practice prohibitions that exclude use of GMOs and other technologies serve as proxies for performance or do they lock in the organic sector in unhelpful ways? Can we use the GMO discussion as way to move towards networks to foster effective participatory governance to realize goals exposed by the organic/regenerative agriculture communities?

If you are interested in contributing as an author to this effort, submitting questions or themes, or serving as a guest editor please let us know. (mwander@illinois.edu). Publication fees for contributions will be covered through our partnership with INFAS.

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Understanding Seed and Intellectual Property Rights

Paulina Jenney, University of Montana

Will Gallagher, University of Maryland

Paulina Borrego, Mass Aggie Seed Library, University of Massachusetts Amherst

Daniela Soleri, University of California - Santa Barbara

Kiki Hubbard, Organic Seed Alliance

Introduction

In the last 150 years, much of the genetic diversity in our food system has been lost, primarily due to the industrialization of agriculture and consolidation of power within the seed industry. Emboldened by federal laws and judicial decisions, major seed companies have tied up unique and novel varieties with restrictive intellectual property rights (IPR), an arrogation of policy originally intended to spur innovation and increase the diversity of seeds available to farmers and growers. Instead, these political and economic forces have created a market structure in which just four companies control sixty percent of the world's seed stock (Howard 2018). Growers focused on maintaining or increasing seed biodiversity, many of whom operate outside the mainstream, are left to reclaim IPR strategies that have been historically used to their disadvantage. Further, because the application of IPR to living organisms is a relatively recent and ill-defined concept—both biologically and in its lack of legal precedent—there remains considerable uncertainty about how diversity-focused seed growers should approach the question of protecting the integrity of their seeds and their livelihoods in this new legal and economic landscape.

A Brief Overview of Seed IPR, Will Gallagher, University of Maryland

The primary goal of patent law is to promote advancements in scientific knowledge and public welfare, and the system must in practice navigate a delicate balance between benefitting inventors and the public. One of the most significant developments in seed policy has been the Supreme Court's controversial decision to extend utility patent protection to seeds, plants, and plant traits. Utility patents are by far the most formidable type of protection in the patent family. Although they were the very first type of patent to exist and remain the most common, they were only first granted for plants beginning in 1985. A utility patent grants the developer of a new plant variety the right to exclude all others from making, using, selling, or even possessing the variety without permission for 20 years. In return, detailed information is released into the public domain about how the applicant combined existing knowledge to produce the new variety.

Two distinct Congressional statutes predate the utility patenting of plants: the 1930 Plant Patent Act (PPA) covers asexually reproducing varieties, and the 1970 Plant Variety Protection Act (PVPA) covers sexually reproducing plants. The PVPA has two important exceptions: the buyer retains the right to save the seed for replanting and breeding, which includes using a PVPA-protected variety to develop novel varieties. These exceptions embrace a belief dating back to the dawn of agriculture that seed-saving and regional adaptation form part of the natural rights of farmers. In the modern landscape dominated by utility patents, seed-saving and breeding research with patented seeds have mostly been foreclosed because utility patents eschew these exceptions.

Before the 1980s, there was not widespread support for the idea that living organisms could be patented, and courts had built up a formidable body of precedent holding that "products of nature" that fell outside of the scope of the PPA and PVPA were unpatentable. But as a result of the Court's ballooning interpretation of patentable subject matter, patent examiners now grant utility patent applications on nearly anything that relates to agriculture, including entire plants, stems, seeds, leaves, chemicals, breeding techniques, and even applications of a plant for specific medical and industrial uses.

By leveraging utility patents alongside restrictive licensing agreements that dictate how patented seeds can be legally used, industry giants have been able to extract significant concessions from farmers and public breeders. Monopolistic control over the seed supply also drives up prices, reduces biodiversity, and threatens the stability of numerous ecosystems. The vast majority of genetic modifications made to crops by private industry breeders confer resistance to a specific insecticide or pesticide; efforts to improve nutrition, taste, yield, soil health, or effect other positive traits are less profitable to the industry and thus scarce.

In addition to the formal patent and patent-like protections afforded by plant patents, utility patents, and PVP certificates, the realm of applicable IPR also includes trade secrets, trademarks, and contract law. Of these three, contract law can be the most onerous to navigate, as contracts can override certain exemptions or add additional stipulations to existing protections. Contracts can also be written in such a way that they expressly prohibit the application of patent protection to seed and its progeny, as is the case with OSSI-pledged varieties and seed exchanged within the Indigenous Seed Keepers' Network. The Organic Seed Alliance has put together a table that breaks down the different types of IPR that may apply to seed. The table can be accessed at this link:

https://seedalliance.org/wp-content/uploads/2020/09/IPR-Table_Organic-Seed-Alliance_SPW.pdf

While companies are generally free to license their IPR on the most favorable terms possible to them, concerns such as market fairness, farmer integrity, and promoting overall resiliency and sustainability in the agricultural system must be part of the equation when the IPR covers something so fundamentally important as the food we eat.

People and Free Resources to Help Seed Growers, Paulina Borrego, Mass Aggie Seed Library, University of Massachusetts - Amherst

The United States Patent and Trademark Office (USPTO) offers a variety of resources for inventors and the public to learn about patents and trademarks. Besides a wealth of videos on their YouTube channel, coupled with the vast information found on their website, there are some lesser known resources that are worthy of investigation.

Patent and Trademark Resource Centers (PTRCs) are located across the country and offer education to patrons by USPTO trained librarians. PTRCs are located in almost every state and housed in academic, public, state, and special libraries open to the public. While each PTRC is different in staffing and strengths, the core set of services provided to the public remains the same.

The PTRC program began in 1871 to help carry out the mission of the USPTO. The role of the PTRC is to disseminate patent and trademark information as well as support the diverse intellectual property needs of the public. At the time the program was established, patent and trademark information was solely paper-based and therefore providing safe storage, organization, and access to materials was the main focus. Today, with the majority of materials being available online (color plant patents being the one exception), much of the work in a PTRC is to help users locate and navigate through information on the USPTO website, gain access to online filing systems, understand the patent and trademark processes, and teach users effective strategies for patent and trademark searching.

While these librarians cannot offer legal advice or help fill in applications, they can help people understand the processes and how to use the various tools and resources. PTRC Librarians are skilled at meeting patrons where they are in their level of knowledge and helping scaffold the information they need. They are familiar with the resources available to the public such as the Pro Se Assistance Program, the Patent Pro Bono Program, and offices such as the Inventors Assistance Center. Many PTRCs offer free programs and training to the public, as well as information about trainings at regional offices and the USPTO. Most of all, PTRC Librarians are committed to helping patrons, devoting themselves to answering questions and explaining information - all for free! Any seed grower is welcome to consult a PTRC librarian as they begin investigating IPR and seed.

An IPR Toolkit for Seed Growers, Paulina Jenney, University of Montana

Because the onus of deciphering different intellectual property strategies often rests on seed growers, many of whom have little experience or financial resources to enter the legal arena, OSA is developing a resource that seeks to increase literacy on intellectual property. The toolkit will include a cursory introduction to the ascendance of IPR and its contribution to the concentration of power in the seed industry during the past 150 years, as well as a description of commonly-used IPR strategies in plant breeding and seed stewardship. The intention of this resource is not to provide a top-down instruction manual on how best to implement IPR strategies into seed work. Rather, it is intended to be a living resource that will be shaped by people working within the community. It will, as much as possible, be told in the voice of people who work with seed and include a range of perspectives on a topic that has no clear right answer. Through in-depth interviews with seed growers, the resource will include specific examples of people who have leveraged – or explicitly chosen not to leverage – one or more forms of IPR to protect a variety they have developed or stewarded. Each section will include an interview with a person who can speak to the attendant time, labor, and financial expenses associated with specific IP strategies.

So far, we have conducted 15 interviews with growers who range in affiliation from backyard hobby breeders to university breeders, variety stewards, seed banks, and exchange groups, and representatives from seed companies both small and large. One of the most emergent themes across the interviews is that while many seed growers in the organic community engage on a legal and technical plane of intellectual property rights, there also exists a communal "soft" form of intellectual property protection in an ethical code of understanding built on personal relationships within an inherently small community. Recognizing and naming the importance of trust, respect and open communication among seed stewards and plant breeders helps to reinforce particular "best practices" that are upheld when exchanging, researching, and selling unique varieties of plants. This project aims to illuminate the nuance in different approaches to IPR and name common best practices as shared by members of the community, as well as to educate seed buyers about how IPR affects the seed they work with. Several seed growers who participated in interviews emphasized a need for more transparency about how IPR follows seed as it moves from grower to retailers. Information about how to tell if seed has associated IP restrictions will be included in the presentation. Participants in the panel will also have an opportunity to ask additional questions or suggest other inclusions that might be useful in the presented toolkit before its publication is finalized in late spring of 2022.

Scenarios as a Tool for Centering Community Values and Demands in Seed IPR Policy Development, Dr. Daniela Soleri, University of California, Santa Barbara

Important work is being done to redesign intellectual property (IPR) policies with a clearer focus on equity, and countering the colonial foundation of IPR to date. A complement to global and national policy work are approaches for ensuring that realistic conditions and community voice are a prominent and integral part of policy development. This complementary work can be especially urgent for the communities whose crop genetic resources have been taken without permission, or even consultation. I'll describe an example of one past attempt at such an approach, community consideration of IPR scenarios regarding their crop varieties among members of the Pueblo of Zuni. In the mid 1990s, in response to community concern about examples of appropriation of tribal names, and perhaps genetic resources, the Zuni Folk Varieties Project created a series of locally-relevant IPR scenarios that took into consideration substantive ideas underpinning IPR discussions such as what constitutes a crop varietal identity, individual vs group authority and control of genetic resources, commercialization of seeds vs food, and appropriation of tribal names. The goal was for farmers and other community members to define the first steps in discussions, and to test the methodology itself. Constructing and using locally-relevant IPR scenarios is one tool that could be useful in discussions and decision-making about IPR policy to ensure that policies and practices reflect the values and demands of farmers, gardeners, seed stewards and their communities.

Conclusion

Seeds do not fit neatly into the utility patent model for several reasons. They are unique among patentable inventions because they produce food—a universally recognized human right. They are the only patentable item that replicates when planted in the ground, implicating legal questions about the scope of the patent owner's rights that have sparked confusion and ire among farmers. While it is true that the scope of utility-patentable subject matter is expansive, the PPA and PVPA were genuine efforts by Congress to bring plants and seeds within the scope of IPR protection in a particular way. And while patent law typically characterizes inventiveness as an "isolated, individualized achievement of an identifiable inventor," these ideas are particularly at odds with traditional breeding, where cooperation, creativity, and the sharing of seeds and knowledge have historically played a significant role.

We need to rebalance the playing field in order to steer current practices back into alignment with the spirit of IP law and foster an equitable and healthy agricultural system. We believe that by highlighting the ways current intellectual property regimes have failed to increase seed diversity, and by increasing access to fair and reasonable strategies for the small-scale grower to protect their livelihoods and their seeds, we can create a food system that is more diverse, and thus more resilient, for the world to come.

Global Seed Justice: What Open-Source Offers

Daniel Wanjama, Seed Savers Network

Georie Pitong, MASIPAG

Johannes Kotschi, Global Coalition of Open Source Seed Initiatives (GOSSI)

Patrick van Zwanenberg, University of Buenos Aires

Shalini Bhutani, Legal Researcher & Policy Analyst

The Global Coalition of Open-Source Seed Initiatives (GOSSI)

The Global Coalition of Global Open-Source Seed System Initiatives (GOSSI) is an international network of organizations and individuals - farmers, seed keepers, plant breeders, researchers, activists, etc. - working to ensure that seeds can be freely used and shared in perpetuity. Seeds as commons, freely accessible, locally adapted and high performing, are urgently needed to cope with the severe social and environmental challenges now facing agriculture and food supply.

GOSSI considers seeds as commons a necessity and open-source strategies a compelling alternative to the interlocked challenges of concentrated corporate power and intellectual property rights.

An "open-source seed system" is an integrated chain of practices linking the breeding, multiplication, use, and exchange of seed. The distinctive feature of "open-source seed" is an expressed and explicit commitment—legal, ethical, or organizational —to maintain freedom to use the seed and any of its derivatives.

GOSSI has adopted a set of core principles applicable to all open-source seed projects that can be adapted to local contexts.

- Anyone may freely use open-source seed - that is, grow it, save it, propagate it, develop it further, and use it for breeding.
- Recipients of open-source seed may not privatize the seed or its progeny through exclusive intellectual property rights or other use restrictions.
- Recipients of open-source seed must assign the same rights and obligations to subsequent recipients.
- The breeder of open-source seed shall be recognized through attribution of credit.
- Benefits shall be shared all along the seed value chain.

People and organizations all over the world have been inspired by its potential for seed freedom. It is now a system that is being enacted and is working in multiple locations in the Global North and the Global South. In the following, a few examples of GOSSI members' work will be presented.

Open Source and Farmers' Rights - the case of Kenya

Farm-saved seed is existential for agriculture and nutrition in Kenya. Most vegetables, tuber crops and minor millets depend almost entirely on farmers' breeding, and their seed production.

Therefore, Kenyan Seed Savers Network (SSN), has the overall goal to strengthen farmer managed seed systems and to enhance Farmers' Rights.

SSN is a national NGO that represents more than 2,500 farmer groups with approximately 58,000 members, the majority of them being women. It does capacity building of farmer groups, enhances farmers' seed enterprises, and establishes community seed banks. Since 2017 the organization has taken lead in promoting open-source seeds in Kenya. Grounding work is the creation of an online seed exchange platform with 65 farmer cultivars documented.

Since recently, SSN focuses on protecting farmer crop cultivars as commons in order to maintain free access to germplasm for farmer led breeding and prevent their seeds from appropriation by intellectual property rights. This support is essential to strengthen food sovereignty, to improve adaptation to climate change and to secure an adequate food supply. The introduction of an open-source seed license into rural seed systems can strengthen the informal seed sector legally and politically. The license provides protection against appropriation of local crop cultivars that are increasingly taken by public research institutions, then registered and put under Plant Variety Protection. The following measures are undertaken:

1. Protection of local cultivars. Protection can only be given to something which is known. Identification, description, open-source licensing and documentation of cultivars have therefore high priority and adequate methods are being developed.
2. Seed exchange and marketing. Based on Community Seed Banks, SSN supports an informal seed marketing system and manages successfully an online seed information system. Both will be further elaborated, and their portfolio enlarged by a new section on open-source licensed varieties and related information. This platform also includes the creation of improved seed exchange facilities online. Training of farmer groups in seed production and marketing, stakeholder meetings and a feasibility study concerning informal and formal seed enterprises for farmer seeds are important complements.
3. Capacity development. Awareness creation, lobbying and advocacy for seeds as commons and managing the open-source strategy as an implementation mechanism represent a third essential avenue in the SSN's work. It addresses different stakeholder groups: farmers, farmer plant breeders and seed producers. In addition, the project offers information and training events for governmental extension staff, scientists of national research stations and representatives from other NGO, committed to agricultural development and biodiversity conservation.

Participatory approaches are applied for all components, as they are essential for a sustainable impact of the project. In summary, SSN has entered into a highly innovative and challenging phase of its work to strengthen Farmers' Rights.

Seeds as Commons and Participatory Plant Breeding in the Philippines

MASIPAG is a network of farmers, NGOs, scientists and researchers in the Philippines. It pursues the goal of putting seeds as a commons into solid and widespread practice on the ground in defense of Farmers' Rights. MASIPAG addresses farmer organizations and communities, that are capable of making collective and autonomous decisions to manage community-based seed banks, and to expand and operate a seed exchange social network. These practices have been built-up through 35 years of work.

MASIPAG follows the conviction of "Seed is Life" and concludes that life is sacred. Therefore, seeds should be managed free of patents and as a commons and a basic need for biodiversity maintenance, food security and ultimately human survival. As stewards of the earth's rich agricultural biodiversity, farmers and indigenous communities are primary food producers. The enormous contribution of rural communities and farmers of all regions of the world, in conserving and developing crop genetic resources is well recognized by the international seed treaty (ITPGRFA).

MASIPAG started its work on seed conservation, plant breeding and seed production with rice, be-cause rice is a staple food in the Philippines. Later on, it also included maize, local vegetables and tuber crops.

Every year, community-managed trial farms and seed banks led by farmer organizations are established to serve as a research and learning laboratory and as a venue for exchange of formal and practical knowledge of farmers in partnership with scientists and researchers.

As of 2020, there were more than 2,000 rice varieties collected and maintained by farmers in the nationwide network, with no less than 600 traditional rice varieties. Next to conservation, 1,299 rice varieties were newly developed in MASIPAG, from which 506 came from participatory breeding projects. Currently, 20 farmer rice breeders and 12 farmer-corn breeders continue to develop new crosses (rice) and improved traditional cultivars (maize) respectively.

In response to adverse agroclimatic conditions and climate change, MASIPAG staff and researchers have identified rice varieties with particular adaptation characteristics. This includes: i) 12 flood tolerant, ii) 18 drought tolerant, iii) 20 saline tolerant and, iv) 24 pest or disease resistant varieties.

With at least 500 member-people's organizations, 41 NGO partners, 20 church-based development organizations, 15 scientists-partners, MASIPAG has reached 63 of 80 provinces in the country, with at least 40,000 farmers. Over time and changing contexts, MASIPAG has evolved from a simple project into a farmer-led network and a movement working towards sustainable use and management of biodiversity through farmers' control of genetic and biological resources, agricultural production and associated with knowledge development. The MASIPAG network stands firmly to its "People first before Profit" philosophy.

Linking stakeholder capabilities to strengthen seeds as commons in Argentina

Bioleft is an open-source seed exchange and breeding initiative that was established in Argentina in 2018. Its purpose is to create a community of farmers, breeders, extension workers and others to experiment with and support an alternative to the dominant seed innovation system. We aim to better support diverse forms of agriculture, such as those practiced by small family farmers, and by agroecological, organic and biodynamic producers, whose needs, production contexts and constraints are ignored by existing seed systems. We have created a digital platform for exchanging seeds and information, which we also think can support collaborative breeding, using open-source licenses and principles to create a commons in germplasm resources.

Bioleft currently consists of a core team of agronomists, public sector plant breeders, farmer-breeders, extension workers, software programmers, an intellectual property lawyer, a small seed firm, a representative of a Ministry of Agriculture initiative concerned with seed access for small farmers (SemilaAR) and university researchers from both the natural and social sciences. Bioleft has also created a wider supportive network. It includes sympathetic officials and scientists from government (e.g. the Ministry of Science, Technology and Innovation, the National Institute for Agricultural Technology, the National Agency for Seed Registration), national and regional farming organizations (representing small scale family farmers, indigenous farming communities, and organic and agroecological producers), as well as agronomy departments in regional universities, and scores of individual farmers, farmer-breeders, and growers.

A key ambition of Bioleft is to explore useful and practical ways of linking local and scientific knowledge to enhance the role of farmers in seed conservation and breeding, and to create synergies be-tween dispersed 'innovation capabilities', and indeed create new capabilities. When we started Bioleft we met farmers working in low input production systems that were unable to find suitable seeds in commercial markets and so, informally within their farming communities, were attempting to breed well adapted seeds for their needs. We also met university plant breeders who were breeding varieties suitable for, say, small scale family farming or agroecological production, but these often went no further than their university greenhouses, because public sector breeders had little access to finance beyond their salaries, and had no way of commercializing or distributing varieties that the private sector was not interested in. Small-scale family farmers have a long history of sharing seed, and of selecting good performing seeds, but informal seed exchange, and certainly any organized efforts to improve farmer seed varieties, are or would be technically unlawful in Argentina. People from all three communities were enthusiastic about ideas about commons based, collaborative forms of seed innovation, and crucially, were committed to becoming part of Bioleft and seeing whether we could together turn those ideas into practice.

Over the last three years we have been running collaborative breeding experiments linking public sector breeders, farmer-breeders, and farmers - with organic maize varieties, and old local tomato cultivars that were recovered from global seed banks We have been working out how farmers and breeders' different preferences and knowledge, e.g. about desirable traits, can be negotiated, how geographically dispersed 'trials' in farmers' fields can be conducted, and how information about seed performance can be gathered and made useful, via our digital platform.

Developing commons-based funding strategies for organic plant breeding in Europe

With the extension of organic farming in Europe, the need for well-adapted cultivars is growing rapidly. The use of organic seed is legally required, organic cultivars are essential to exploit the full potential of organic production and both are increasingly demanded by consumers. But the development of organic plant breeding and seed production has not kept up with the increase of the area under organic cultivation in Europe. Lack of financial resources for organic plant breeding is commonly seen as a main reason. Therefore, Agrecol, the association for AgriCulture and Ecology identified new business models and analyzed the potential impact of open-source seed systems on funding of organic plant breeding.

As a first step, Agrecol analyzed the status quo of funding and discussed solutions to improve the situation. An international survey and interviews with breeders served to assess sources of funding (Kotschi & Wirz 2015). Testing a new strategy to protect seeds as commons with an open-source license focused on finding non-proprietary concepts of financing. An interdisciplinary international workshop with breeders, seed producers and commons experts explored alternative financing concepts in the context of seeds as commons (Kotschi and Doobe 2019). In addition, an open-source wheat cultivar was developed and promoted along the value chain. An "open-source bread" was used, to analyze the potential, of involving consumers in funding organic breeding.

The survey confirmed that limited funding is the main constraint for the extension of organic plant breeding. Interestingly, the largest share of funding comes from donations, a smaller part from seed sales, whereas royalties from plant variety protection (PVP) - the classical source of funding - contribute little or nothing to finance plant breeding. A survey among cereal breeders revealed that foundations alone contributed 35-81%, whereas royalties from PVP contributed 0-12% to cover the costs for breeding (Kotschi and Wirz). There are various reasons which explain why funding based on intellectual property rights (IPR) had little impact: i) the area under cultivation with organic cultivars is too small to generate sufficient income from royalties, ii) large scale production based on few cultivars contradicts the need for diversity in organic cropping systems and iii) the majority of organic plant breeders consider their cultivars a commons and reject IPR.

In a search for alternatives, no general solution was found, but various new business models were identified. The most promising are i) to involve various stakeholders in the value chain, ii) to introduce a label for commons based organic plant breeding and iii) to establish community-based plant breeding. A combination of approaches could become a powerful alternative strategy to significantly increase the overall budget for organic plant breeding. Generally, it was concluded that an approach based entirely on non-proprietary plant breeding and without IPR is more promising as a mixture of both. The positive reaction of consumers to the Open Source Seed Licence (Kotschi and Horneburg 2018) suggests that applying the open-source strategy outweighs the disadvantages of renouncing royalties.

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Reflecting on the Organic Seed Production Course, and Next Steps for Seed Production Education

Kitt Healy, Organic Seed Alliance

Amber McConnon, Organic Seed Alliance

Ana Galvis, Organic Seed Alliance

Jared Zystro, Organic Seed Alliance

Jay Bost, GoFarm Hawaii

Laurie McKenzie, Organic Seed Alliance

Melony Edwards, Organic Seed Alliance

Micaela Colley, Organic Seed Alliance

Natalia Pinzón-Jiménez, Rhizobia

In 2020, Organic Seed Alliance launched the online Organic Seed Production Course and Mentorship Program. Since then, 65 students have matriculated through the course over the past two seasons, and their feedback has shaped each iteration of the course content and design. The course is hosted on the Organic Seed Commons, and offers 6 learning modules over 6 months, with two live sessions per month. The course combines hands-on learning, farmer profiles, technical information, cultural perspectives and peer-to-peer community building. In doing so, the course design draws influence from a variety of other farmer education and seed saving education efforts, both institutional and community-based.

As we prepare for the next season of the course, the OSA curriculum development committee is hosting an open conversation with anyone who has an interest or experience in seed production education. We will be applying for additional funding to continue to grow and deepen our educational offerings, and acknowledge that we do so in community and in lineage with other organizations and individuals who share this work. Those who join this roundtable might be interested in participating in a seed course in the future, or maybe alumni of the Organic Seed Production Course who would like to share aspects of their experience. Participants might also be educators, trainers, or seed growers with an interest in shaping the educational offerings available to their interns and employees. The curriculum development committee is also interested in meeting and collaborating with representatives of farmer training programs who might like to work with us on the next iteration of this course, or might be interested in using parts of the curriculum in their programs.

Perspectives on Seed Policy

Andrea Carter, Native Seeds/SEARCH

Alexandra Zamecnik, Native Seeds/SEARCH

Jacob Butler, Native Seeds/SEARCH

Sheryl Joy, Native Seeds/SEARCH

Tudor Montague, Native Seeds/SEARCH

Native Seeds/SEARCH (NS/S) is a seed conservation organization based in Tucson, Arizona. For over 38 years our organization's mission has been to preserve the seeds of the Greater Southwest so that these arid adapted crops may benefit all people and nourish a changing world. Our stewardship involves not only the distribution of seeds through retail outlets, but also the sharing of seeds through free seed access programs for Indigenous people of the region as well as community gardens and farms.

This past year, we at NS/S reflected on our role as stewards of the seeds, listening to our stakeholders, and redefining our role in sharing these seeds, both to the communities with cultural connections, as well as the public. We also reflected on the importance of these arid-adapted seeds in the future of small farming as the climate continues to change. In a region with growing industrial agriculture that relies on unsustainable water and resource use, the conservation of these seeds continues to be critical. However, the conservation and sharing of these seeds must be done hand-in-hand with the communities that grew and cared for these seeds for generations.

We formed a Seed Policy Committee with members from the Board of Directors and staff to define a Seed Policy to evaluate, restate and redefine the stewardship of the seeds. The Policy outlines the stakeholders of the organization, the seed management processes, documentation, health concerns, tribal relations, and research considerations. The redefinition of our Policy was a process of bringing the staff and Board of Directors together to agree on our responsibilities as seed stewards and managers of this seedbank. The discussions that took place were often tense and emotional, but they were rooted in reverence for the seeds and the desire to see them abundantly grown in their communities of origin and beyond.

This Policy defines new ways of sharing seeds, including seed donations and rematriation, and includes processes for incorporating Native voices into the management of the seeds, as Board members and staff, and through tribal engagement and consultation. This Roundtable session will include an overview of the new policy as we hear from those directly involved reflect on the process and outcome.

Non-Binary Botany

K Greene, Hudson Valley Seed Company

Luis Campos, Rice University

Rian Ciela Hammond

Hawthorn McCracken

Christian Keeve, University of Kentucky

This roundtable will introduce ongoing work and conversations centered within non-binary botany and queer ecology. The session will begin with short video presentations of diverse scholarly, artistic, and lived-experience approaches to non-binary botany. This will be followed by a facilitated full group discussion where we reflect on the presentations and continue to constructively question the current dominant binary approach to plant classification. Our hope is for the group to share diverse approaches to non-binary botany in ways that open up possibilities for how we talk about plant reproduction while celebrating our relationships with botany, seeds, and plants.

Labor in the Organic Seed Movement

Clint Freund, Cultivating The Commons

Edmund Frost, Common Wealth Seed Growers

Garrett Graddy-Lovelace, American University

Kathia Ramirez, El Comite del Apoyo por los Trabajadores Agricolas / Farmworker Support Committee (CATA)

Reily Ney, Snake River Seed Cooperative

The organic/regional seed movement has initiated a challenge to corporatized and globalized seed systems. But in what ways do global and corporate paradigms still shape and limit what we are doing, especially in terms of labor? Unless you have a stable job with a larger alternative seed company or organization, it is often a struggle to make a living in seed production or seed research, or to have reliable access to farmland. This in turn limits the pool of new seed farmers and workers, and the potential of our movement. We will touch on strategies seed workers are currently using to make ends meet, including starting new retail seed companies and growers cooperatives, and using grant funding.

Much of the session will be spent envisioning changes we as a movement might make to better sustain seed workers and to make the work accessible to more people. Some questions we'll be asking include:

1) How can we better name and navigate the reality of competition with a poorly paid global labor market?

2) How can we organize as seed workers to advocate for our needs? We'll consider models from existing farmer and farmworker organizing and advocacy groups, and consider particular needs and complications for organic seed workers, e.g. doing retail sales, research, and plant breeding as well as contract growing, and also growing and selling food crops.

3) How and to what extent can communicating to seed purchasers the value of sustainable and fair compensation for seed workers help?

Addressing Seed Grower Concerns with Organic Certification: Inspection Experiences on the Organic Seed Alliance Research Farm

Laurie McKenzie, Organic Seed Alliance

The Organic Seed Alliance (OSA) research farm in Chimacum, WA has been certified organic since 2015. Over the past six years we have had widely varying experiences with our organic inspections – ranging from the first inspection that took a full, exhausting day to our most recent that was three hours of ease and affirmation. While we are a unique farming operation that presents any inspector with a challenging inspection given the research nature of our work, several of the inspections were so frustrating and exasperating that I found myself questioning the whole certification process and the need for and value of certification. The ongoing burden of proof and extensive need for documentation to back it up to show that your farm practices are organic and sustainable is a shared frustration among many growers and farmers.

The OSA research farm is located on a shared property that hosts several certified organic farming operations. Although all of these operations, known as land partners, are certified organic, they each maintain their own, separate organic certifications. These land partners are all certified through the same agency, with the exception of OSA, who maintains its organic certification through a different agency. Our experiences have shown a wide inconsistency among and between inspectors and certifying agencies; the difference in rigor, depth, and length of inspections we experienced compared to the other land partners has been striking. There is a clear need for more consistency and efficiency in the inspection process both among inspectors within a given agency as well as between agencies.

I came to OSA with over a decade of certified organic farming experience and felt confident that I knew what to expect and how to run and operate a certified organic farm, although I had never gone through an organic inspection myself. The first inspection for organic certification at the OSA Washington research farm was an intimidating and agonizing experience for me. It was clear from the beginning that the inspector was not prepared and did not understand the nature of the work that OSA conducted. The amount of time that I had to spend explaining why our work and farm were set up the way they are felt burdensome and unfair, as that was time the inspector was being paid for that seemed like it was catching them up on background research they should have done beforehand. I felt unprepared in my record keeping and understanding of the documentation that I should have been keeping and felt that the inspector was trying to trap me into admitting misconduct by asking me the same questions multiple times. Over the years we have improved our systems and documentation at our Washington research farm. However, overall, the annual inspections have continued on a trend of frustration and excessive length.

Here are some ideas for certifiers to consider that could make the annual inspection process easier and more efficient:

- Have a national standard form for certifying agencies to use as a baseline for consistency
- Include training for inspectors on seed production, seed businesses, and research farming
- Figure out how to adapt the inspection form to the farm – not expecting the farm to conform to the form

- Foster empowerment among farmers and clients to avoid intimidation and undo stress during inspections
- Provide clear and concise guidance on how to prepare for organic certification and inspections – what sorts of things you should be documenting, and what to expect of the inspection
- Provide a feedback loop/opportunity for growers to comment on and share their inspection experiences – both positive and negative
- Understand that not all seed and planting sources can be certified organic and easily documented – the need to have documentation for everything can restrict sharing and integrating new sources and materials onto the farm.

Seed Grower Concerns with Organic Certification

Don Tipping, Siskiyou Seeds

Over the past 2 years, we have transitioned from a certified organic (COG) farm (since 1997) to being certified as a grower/processor/handler, which entailed an undue amount of jumping through red tape hoops. As I see it, the NOP does not have a good route for seed growers, and the certifiers, inspectors, and auditors are confused about how to get us to fit in their tidy boxes designed for food products. We are currently certified with Oregon Tilth, but have been with Stellar/Demeter and Oregon Department of Agriculture's programs in the past. Ever since the government got involved, certification went from 90% field inspection and 10% recordkeeping done by inspectors who generally knew their way around a farm to 10% field walk and 90% recordkeeping by an inspector who oftentimes is fairly naive about farming. To highlight a few of the myriad of challenges:

- Seed Sourcing - we often obtain seed directly from friends, travels, breeders, seed swaps and do not have a receipt for that seed showing it is COG.
- Bringing conventional seed into COG production - this really confuses them! If a variety is not currently available as COG, then someone like us has to take conventional seed and grow it organically in order to offer it for sale.
- Redundant paperwork - As stated above, they have no category for “on-farm seed company” so we have to fill out similar forms with the same information. We are treated as though we are producing a product for human consumption with excessive paperwork.
- Biodiverse farming is penalized - We produce over 400 species on our farm and they force us to detail multiple record-keeping steps for each one; in comparison, if we were to simply monocrop, say wheat, on 1,000 acres our certification would be vastly simpler.
- De-certification - When we transitioned from grower to grower/processor/handler (because we not only grow seed but contract with other growers and often have to do supplemental cleaning on seed lots received, hence processing), our entire backstock was de-certified and not able to be sold as COG, including seed bought from companies such as Wild Garden Seeds a month before the implementation date. Their reasoning was that we may have contaminated our inventory somehow and knowingly sold non-organic seed as organic. This has been a huge setback and logistical nightmare.

- Red-tape - Often the requirements we have to follow come across as red-tape so that the certifiers and inspectors will not be audited rather than bonafide incentives to practice good stewardship of soil, air, and water.

I could go on, but to put it bluntly, organic certification is the absolute least favorite aspect of farming and I have paid thousands of dollars for it. I would rather slaughter sheep all day. I have often thought of dropping it because I question how much the OG label actually means to people these days and it has been so watered down by mega-industrial organics and green washing. I also think that 90%+ of our customers do not need the OG seal. Nonetheless I do it because it is the best option we have right now for quality assurance, and when I shop with my kids, I have long told them that if it does not have the green and white USDA OG label, I am not buying it. Those of us upholding the COG banner go many extra miles to do so.

The Power of Seed Names: Can We Do Better?

Jeanine Scheffert, Seed Savers Exchange

Susana Cabrera-Mariz, Iowa State University

Seed names can be a beautiful connection to identity, culture, worldview and history. Varietal names can often indicate a seed's origin, stewardship history, and phenotypic characteristics. Yet many seeds have variety names that are derogatory in nature or simply incorrect. How do we as an organic seed community honor seeds, their origins, and their stewardship history, while addressing seed names that may need to change?

This conference roundtable discussion brings people together from across the seed industry and seed community to celebrate the importance and nuance of this topic. This topic is large and has far-reaching consequences, so we will continue to ask ourselves, “Who is at the table? Who is not? What impact do seed names have? What is our responsibility as seed stewards to bring this issue to light? What are our possible paths forward?”

Roundtable panelists include Heron Breen, independent seed worker within commercial & community seed, seed saving, plant breeding, and retail/home garden seed business; Shelley Buffalo, Meskwaki Seedkeeper and Americorps VISTA for Sustainable Iowa Land Trust; Craig LeHoullier, PhD, Seed Savers Exchange advisor, author, and amateur breeder; Kellee Matsushita-Tseng, Second Generation Seed collective member/educator and farmer at the Center for Agroecology, UC Santa Cruz; Mehmet Öztan, Turkish seed saver/keeper, farmer, co-owner of Two Seeds in a Pod Heirloom Seed Company, and part-time service faculty at West Virginia University; Sara Straate, Seed Savers Exchange Seed Historian; secondary moderator and notetaker Susana Cabrera-Mariz, Masters Candidate, Iowa State University; and moderator, Jeanine Scheffert, Seed Savers Exchange Education and Engagement Manager.

Three main goals for this session include:

1) Building a community to address the topic of seed names and the logistical and ethical challenges that can arise from changing seed names.

2) Creating a self-defined working group that supports collaboration among diverse stakeholders to continue this conversation.

3) Presentation of progress by representatives of this working group as a panel at the 2024 Organic Seed Growers conference.

Discovering, Connecting and Inspiring a Southeast Seed Network

Chris Smith, Edmund Frost, Melissa DeSa, Ira Wallace, Michael Carter Jr., Megan Allen

Description

The Southeast has historically been underrepresented in the organic seed movement, with most organic and alternative seed companies and much of the organizing taking place in the North and West. This session aims to create an open space for sharing and connecting and discovering existing seed work in the Southeast with the hope of also inspiring more research, plant breeding and seed networking in the Southeast.

Chris Smith and Melissa DeSa will begin the roundtable with a brief introduction to the emerging Southeast Seed Network and summarize the key focus areas of need identified in previous meetings. Edmund Frost, Ira Wallace, Michael Carter and Meghan Allen will each share a little about their Southeast seed work before opening the floor for the main event: YOU! Most of the session is devoted to audience members sharing their own work or projects with the aim of inspiring and connecting people. Based on participation and interest levels we imagine audience members will have 2-5 minutes to share.

In closing, two tools will be explained and shared with the group - the OSA Southeast Regional Seed Network Synergy Space plus the SESEED.org website, which will begin by profiling and mapping seed work in the Southeast as an open resource for connection, community and collaboration.

Proceedings

In 2017 a group of Southeast seedpeople gathered at the Carolina Farm Stewardship Association Sustainable Ag Conference to discuss work that needed to be done towards a Southeast Seed Network. At future southeast conferences the group continued to meet and carry forward some momentum, but it was not until 2019 when grant funding allowed a SE Seed Summit to take place, again at CFSA SAC. That summit invigorated a lot of enthusiasm and led to a SESeed listserve and some stated aims and objectives, but shortly after the world was plunged into pandemic and despite a few efforts (including a rejected SARE grant in 2020) there has been little movement forward.

Vision

A democratic and equitable network of seed orientated stakeholders to support a resilient and regenerative Southeastern food system.

Mission

To champion and support the work of seeds people in the Southeast through coordinating and facilitating the SE Seed Network; To address specific challenges and opportunities in the Southeast with a unified and representative voice.

Priority Focus Areas

- Internal network building (human centric)
- External education - celebrate and promote local seed

- Economics of seed production - make viable
- Create infrastructure for sharing information
- Climate impacts - breeding, trials

This roundtable will begin to address the first priority area of internal network building, which aims to discover and recognize and connect all the incredible seed work that is already taking place in the Southeast. The session will create a space where lots of southeast seed people can openly and safely share their work. This is the first step of a broader aim to document and profile all the work that is happening on a dedicated website: SESeed.org. In addition the Organic Seed Commons SE Seed Network synergy space can be used to further connect, support and collaborate.

Four presenters will share a little about their own Southeast seed work to get the ball rolling before opening it up to the floor:

Edmund Frost has been growing organic vegetable seeds in Louisa, Virginia since 2008 as co-manager of Twin Oaks Seed Farm. He also runs a small regional farm-based retail and wholesale seed company called Common Wealth Seed Growers.

Edmund's work in the field is split between seed production (for several seed companies); variety trials research; plant breeding; and food plantings for home and community use. He has received several SARE and Organic Farming Research Foundation (OFRF) grants for the research and breeding work (more details about the projects are at commonwealthseeds.com/research). The breeding work has focused mainly on cucumbers and butternut squash, but he also does variety trials and selection work with many other crops, including sweet peppers, corn, muskmelon, watermelon, gourds, ornamental pumpkins, tomatoes and basil.

He is passionate about finding, selecting, breeding and sharing crop varieties that are especially well adapted to Virginia and to the Southeast more broadly.

Michael Carter Jr. is an 11th generation American/farmer, and is the 5th generation to farm on Carter Farms, his family's century farm in Orange County, Virginia where he gives workshops on how to grow and market ethnic vegetables. With Virginia State University, he is the Small Farm Resource Center Coordinator for the Small Farm Outreach Program. Virginia Association of Biological Farmers (VABF) and Virginia Foodshed Capital have him sit on their respective board of directors. He also serves as the state coordinator for the Black Church Food Security Network and as the food safety coordinator for the Six State Farm to Table organization. He acquired an agricultural economics degree from North Carolina A&T State University and has worked in Ghana, Kenya and Israel as an agronomist and organic agricultural consultant. As a cliometrician, curriculum developer and program coordinator for his educational, cultural and vocational platforms, Hen Asem (Our Story) and Africulture, he teaches and expounds on the contributions of Africans and African Americans to agriculture worldwide and trains students, educators and professionals in African cultural understanding, empathy, and implicit bias recognition.

Ira Wallace is a worker/owner of the cooperatively managed Southern Exposure Seed Exchange (www.SouthernExposure.com), which offers over 700 varieties of open-pollinated heirloom and organic seeds selected for flavor and regional adaptability. Southern Exposure helps people keep control of their food supply by supporting sustainable home and market gardening, seed saving, and preserving heirloom varieties. Ira serves on the boards of the Organic Seed Alliance and the Virginia Association for Biological Farming (VABF). In addition, Ira is a member of Acorn Community which farms over 60 acres of certified organic land in Central Virginia, growing seeds, alliums, hay, and conducting variety trials for Southern Exposure. She is a cofounder of the Heritage Harvest Festival at Monticello, a fun, family-friendly event featuring an old-time seed swap, local food, hands-on workshops and demos, and more. She presents at events throughout the southeast. She currently writes about heirloom vegetable varieties for magazines and blogs including Mother Earth News, Fine Gardening and Southern Exposure. She also conducts variety trials for Southern Exposure Seed Exchange as well as researching and documenting the history of varieties offered in the annual catalog. Her book, The Timber Press Guide to Vegetable Gardening in the Southeast, and new state specific book series including, Grow Great Vegetables in Virginia, are available online and at booksellers everywhere.

Ira is currently working on creating an African Diasporic Seed Collection. A legacy project for the 70 yr-old seed saver, organic farmer and heirloom seed pioneer who is inspired by the work of Leah Penniman and the folks at Soul Fire Farm. This will be a collection that honors and tells the stories of seeds that have been historically grown by and represent a part of the story of food and farming for black and brown people across the African Diaspora. This project would highlight seed savers in communities of color while creating learning centers and distribution networks that are generated collaboratively by seed farmers in our community. We have the "seeds" of this work already through Southern Exposure, Truelove Seeds, Sankofa Farms, Landreth Seed Company, and the Homowo African Heritage Seed Collection. How can we help to deepen and widen this work to honor the seeds sacred to Black people and get these seeds in the hands of the next generation of farmers? How can we collaborate so as not to duplicate one another's work or compete? So the beginnings of this project are to reach out and learn from folks who are already rooted in black and brown communities. Ira wants to know more about what is already happening and look for ways to cooperate and best use her energy and the resources of Southern Exposure Seed Exchange to create synergies with others.

Megan Allen runs Care of the Earth Community Farm in Corryton, TN, with her partner, Lalo Lazaro. For the last thirteen years, the principal focus of their farm operation has been supplying a 100-member Certified Organic produce CSA. In addition, they grow between 25-30 varieties of seeds per season (about half for contract), do several on-farm variety trials per season (anywhere from 2-8 varieties per trial) and some on-farm plant breeding. They also steward a handful of seeds from Lalo's home region of Hueyapan de Ocampo, Veracruz, Mexico.

Care of the Earth Community Farm have always done several on-farm variety trials, but in recent years the climate crisis has shifted Megan and Lalo's focus to finding open-pollinated seed varieties that are productive in the changing and challenging southeastern climate. When they cannot find varieties they engage in breeding and selection work. They are currently breeding a DMR butternut squash, an all-purpose corn, a DMR muskmelon, a winter kale, and a orange cherry tomato, and hope to begin work this season on a late season DMR cucumber, a late season DMR/pickle worm resistant summer squash and/or zucchini, and a CBS/AN-R op poblano/Ancho.

Lalo's particular focus is on stewarding several varieties of seed he received from the last three diverse farmers (Don Lolo, Don Alfonso, and Don Chico Perez) in Hueyapan de Ocampo, Mexico (where he grew up and where his mother still lives). It is very important to him to continue to save these varieties. He is working on both acclimating them to our region/climate/latitude, as well as identifying traits that could be useful for future breeding projects. He is currently working with a black bean variety, a jalapeno pepper, a dent corn, and a creole garlic. He also has seeds of two different winter squash varieties. The farmers in Mexico plan to send him more seed in February.

As of late January, Care of the Earth Community Farm is ceasing its CSA so they can focus on growing seed for seed companies in the southeast, doing cooperative trials and breeding work with other growers in their region, and continuing their own on-farm trials, breeding projects, and seed stewardship.

Learnings from Participatory Grower Network

Learnings from the Canadian Organic Vegetable Improvement Network (CANOVI)

Solveig Hanson, Ph.D., University of British Columbia

Helen Jensen, Ph.D., SeedChange

The Canadian Organic Vegetable Improvement Project (CANOVI) was launched by the Centre for Sustainable Food Systems at the University of British Columbia and the Bauta Family Initiative on Canadian Seed Security in 2018, with the goal to build a collaborative network of farmers, researchers, and industry stakeholders to conduct variety trials on organic and ecological farms across Canada. Participants in the trialing program have conducted trials of red bell and corno peppers, red and orange carrots, radicchio, and rutabaga. Growers in regional clusters are also trialing tomatoes, squash, and African eggplants. Participants plant single replicates of each variety on their farm site, and they collect and upload data via the SeedLinked platform. The CANOVI network is distinguished by its large geographical scale, with trials in multiple time zones, hardiness zones, soil types, farm types, and climates. The CANOVI trials and associated materials are available in French to growers in the province of Québec.

How does scale impact participatory breeding and trialing networks? How do you decide the geographical and logistical limits of a network? The large scale of CANOVI presents challenges. In particular, it is difficult to identify crops, market classes and varieties that are appropriate and interesting across multiple regions. We have explored a number of solutions to this challenge including: trialing multiple crops in one year (e.g. radicchio and rutabaga) in order to engage participants in a range of growing environments, allowing participants to build their own set of trial varieties from a list of options, and offering trial sets organized by market class and/or days to maturity. Increasing the complexity of the trial network to accommodate scale can quickly overwhelm the logistical capacity of the network and reduce the sample size for each crop and variety. Finding the balance between grower engagement and logistical capacity will be key to the sustainability and scalability of the CANOVI network.

What makes a technological tool (app, communication platform, etc) helpful, neutral, or detrimental to your network's communication? We have used the SeedLinked platform for data collection since 2019, which has allowed for more consistent data formatting and less data loss. We are also able to share initial data with participants much earlier than previously, resulting in more timely communication. We have noted some communication challenges related to the use of SeedLinked. The software is currently only available in English, and this poses an accessibility problem for our francophone participants. Additionally, the numerical 1-5 trait rating system limits our ability to incorporate farmer feedback regarding the most relevant way to collect data for a given trait.

What kinds of knowledge do you feel are valued in participatory breeding or trialing networks? What kinds of knowledge get lost? First and foremost, CANOVI aims to value farmers' knowledge as practitioners on their land. We offer guidelines for trial planting but emphasize that varieties should be grown using the farm's normal system. Participants evaluate varieties from 1 (poor) to 5 (excellent) on several traits of interest, and they respond "Yes" or "No" to

“Would you grow this again?” This system invites comparison of trial varieties to one another and to each farm’s benchmark varieties. The numerical assessment scale favors quantitative and categorical thinking and, ultimately, a binary choice between approving or disapproving of the variety. The resulting numerical data is easy to analyze, effective in distilling meaning from abundant information, and is justifiably focused on the end goal of producing a marketable crop. However, information about the way the variety progressed through the season – how it interacted with soil, insects, animals, and weather – is harder to capture with numerical ratings. In addition, we miss the rhapsody of variety trialing: the unexpected succulence in early Chioggia radicchio leaves, or the haze of purple to green on rutabaga shoulders. We are currently talking with participants about supplementing quantitative trial evaluation with narrative evaluation in optional CANOVI Farm Clubs. These informal in-person or online participant groups that would meet periodically over the season to share their trialing experiences, compare notes on varieties, and hopefully build grower-to-grower connections in the process.

Tell a learning story, or a story of an unfinished effort. 87% of participants (N = 31) who responded to a 2021 season exit survey said that participating in CANOVI trials improved their “skill at observing and evaluating varieties,” but only 48% said trial participation made them “feel more connected to other farmers with similar values and interests.” While some regional participant networks are strong, farmer-to farmer connections within the national CANOVI network have been slower to form. Given the broad geographic range of CANOVI participants, the travel constraints imposed by the pandemic, and limitations of videoconferencing technology, this is perhaps not surprising. However, given the potential benefits of grower-to-grower knowledge exchange and collegiality, we hope to provide more opportunities for informal participant connections.

Seed to Kitchen Collaborative (SKC)

Dr. Julie Dawson, University of Wisconsin – Madison

The SKC connects farmers, plant breeders and chefs in evaluating vegetable varieties for local markets. Over the past eight years, it has grown from a handful of farmers and chefs to over 80 farmers, 30 plant breeders and 12 chefs. Pre-pandemic, trials at agricultural research stations included 20-100 varieties of each of twelve different vegetable crops under organic management. On research stations, we measure yield, earliness, disease resistance and other critical traits, as well as conducting flavor evaluations of all varieties. Up until 2020, each month chefs evaluated varieties from the trial top performers or early generation breeding lines. On-farm trials include the varieties that have done the best in the research station trials and quality evaluations.

The rapid expansion of this project has pointed to the demand for research-based information on variety performance. While research station trials collect data on quantitative traits in organic systems, they do not represent all the environments or the diversity of organic systems present in the Upper Midwest. The SeedLinked beta testing program in 2019 validated the crowdsourcing approach to collaborative variety trialing with the SKC network of growers and a large number of additional farmers and gardeners in other regions. The pandemic has resulted in a scaling back of research station activity and more emphasis placed on on-farm trials in collaboration with

SeedLinked. SeedLinked is also making it easier for farmer-initiated or breeder-initiated trials to develop in addition to trials designed by the SKC.

In addition to the farmers and chefs participating in the SKC, stakeholders from throughout the organic seed industry have guided its development. A Midwest Organic Seed Summit was convened in Madison in October 2019. A key request was a regional community of practice around organic seed systems. Other critical needs were tools for on-farm, decentralized trialing in increasingly erratic environments, and more advanced training for independent breeders and seed growers. Conversations with participating farmers at the SKC annual meetings have emphasized farmers' desire for more streamlined data sharing and trial management tools.

Other priorities for SKC farmers include on-farm plant breeding education and avenues for expanding on-farm research. While some farmers prefer to trial varieties that are either already commercialized or will be in the near future, a significant number have asked to be involved earlier in the breeding process, where their input will have the most impact.

Independent breeders and small regional seed companies are an underappreciated sector of the organic seed industry but are critical to producing varieties that are regionally adapted and suited to organic systems. Independent breeders and regional seed companies may have breeding lines with traits of interest to organic farmers. These independent breeders and small seed companies need access to more cost-effective trialing options, and also desire training on scaling-up seed production or licensing varieties to mid-sized retail seed companies. Often participatory breeding takes the form of breeders seeking out farmers to conduct on-farm trials. This model works well for crops for which a formal breeding program exists in a region. But, because of the lack of investment in plant breeding in general, and for organic systems in particular, there are many crops and regions for which there are no public or private sector breeding programs.

This points to a need for new models to develop varieties for organic farmers. Expecting full time organic vegetable farmers to all become farmer-breeders and develop their own varieties for crops where they have inadequate variety choices is unrealistic. Vegetable farmers are incredibly busy during the growing season, and while they may be interested in conducting selection on their farms, most are not able to add another full-time job as breeders to their more-than-full-time work as farmers. Independent breeders and small seed companies can bridge this gap, and we are working within the SKC and with Organic Seed Alliance and SeedLinked to develop a model of connecting independent breeders with a network of farmers interested in evaluating early generation crosses on their farms, and to tools and resources to do so in a time and cost-effective manner.

Farmer Experiences and Perspectives from a Participatory Plant Breeding (PPB) Program for Organic Wheat and Oat in Canada

Iain Storosko, Carleton University

Helen Jensen, Bauta Family Initiative on Canadian Seed Security

From 2013-2017, the University of Manitoba (Canada), in collaboration with the Bauta Family Initiative on Canadian Seed Security, implemented a national PPB program to develop wheat and oat varieties in collaboration with Canadian organic farmers. Initial crosses were made at the

University of Manitoba's Natural Systems Agriculture lab, and seeds of the F3 generation were delivered to participating farmers for selection on their farms until the F6 generation. Farmers were encouraged to make selections based on their own production practices and to select for traits they find most practical for their regional contexts. Agronomic data from the program indicates good performance and high yield of the farmer-selected varieties under organic conditions. However, there is not yet a strong set of data relating to farmer selection practices and the broader context within which the PPB work is situated.

In a project conducted over the 2020 season, we conducted open interviews with organic farmers participating in the program to address the following research questions: (1) What methods do farms deploy to select desired crop traits and why are these methods used? (2) What strengths and limitations do program participants face and how do these relate to either farm-scale systems or industry structure in Canada? (3) How do participating farmers perceive the function of PPB in the broader context of organic agriculture development?

Study results have shed light on some of the following areas: Grower-to-grower-to-researcher connections from this network played significant roles in the experiences of plant breeding or variety trials. Many of these connections have enriched the degree of information shared, as well as the resources, both physical and intellectual, transferred between farmers and within regions. Examples included shared equipment, seed varieties, and diversified methods for trialing/selection.

There is a considerable amount of agronomic knowledge attained by participants for organic production in general. The collaboration with universities and the technical capabilities was considered a major strength of this program. Knowledge of heritage varieties and specific adaptations to extreme weather conditions was obtained as well.

The statement, "Being part of a grower network is of equal or greater value than the materials that come out of it" rings absolutely true within the context of our program. Almost all of the farmers interviewed in our study expressed this sentiment in some way and would agree that the network itself (and the knowledge and resources attained through it) could be considered of greater value than the materials that come out of the breeding trials.

There are geographic and logistical challenges associated with the further development of markets for the farmer-selected varieties. In particular, logistical challenges separate the regions where PPB grain is grown economically, and the regions with key markets (e.g. direct-to-consumer and artisanal). A complex and costly registration process combined with the low price garnered in the international market makes it unfeasible to grow PPB grain at an acreage beyond that which can supply local markets.

Learnings from Participatory Grower Networks

Christian Keeve, University of Kentucky

In spring of 2021, a friend and I started a local decentralized seed network in Lexington, primarily via Google Docs, a spreadsheet, and an email list. We were inspired by emergent projects like SeedLinked, the London Freedom Seed Bank, the Cooperative Gardens Commission, and more; but it has not yet taken off the way we had hoped, likely because the initial stages of buy-in were not readily apparent through the platform itself. However, there was some engagement and it does provide a grounding location for further projects, organizing, etc.

With participatory plant breeding, I am interested in the need to form a fundamental set of common denominators, or shared grammars of understanding. One person's interpretation of yield or earliness needs to be functionally comparable to anyone else's in the network in order for the data to prove useful; a shared understanding of what is being asked, about which crops, how it is being asked, and why it is being asked. But what if there is not shared understanding? What is the network to do with the forms of knowledge, understandings, or data that are not readily comparable across different geographic and socioecological contexts? Further, how is the network to reckon with an approach to interpretation that is not predicated on individual growers with a reliably shared understanding, but instead of knowledge coming from agroecological communities (human and nonhuman), with their own shared histories and political-ecological investments?

There is a lot to be said about which kinds of knowledge get lost or cannot be captured, for example, personal and communal storytelling, experiential knowledge with particular plants or crop varieties, or even significantly different ways of interpreting relationships with particular crops. But I am increasingly interested in what forms, or politics maybe, of agroecological knowledge may emerge from grower networks that hold the comparable and incomparable in tension? What kinds of generative approaches to knowledge may emerge when one leans into the complexity, the internal contradictions, and the overlapping/intersecting/diverging grammars of understanding? How might that change perceptions of the work that a participatory grower network could do? Of what could be made possible?

In that vein, I wonder at which point scale remains a useful analytic. On hyperlocal (garden/farm) to local (neighborhood/municipality) scales, the network becomes something possibly more intimate, predicated on day-to-day forms of cooperativity necessitated biologically (thinking isolation and cross-pollination), as well as through small forms of resource distribution and quotidian knowledge sharing. There is more likely to be strong commonalities among environmental conditions as well as socio-historical understandings of the work that the network is doing among a longer history of local food and seed ways. Both of those factors also allow for the richness of microclimatic and hyperlocal data.

On larger scales, I am thinking with critical geographies, and especially critical geographies of seed work toward patchy landscapes of agrobiodiversity that are woven together by the logistics of resource and knowledge exchange. On larger scales, it may be more useful to think not in terms of scale, but instead the kinds of geographies that the network brings into being, especially the interconnections of logistics space, digital space, and physical/environmental space. At larger scales, there is likely to be a higher diversity of environmental, social, and geographic conditions, which would likely make it more difficult to establish common denominators or comparisons. However, I wonder what might be gained if one leans into the geographic fragmentation and patchiness of the network (all these different sites with different conditions, histories, ecologies, personal/political investments). How might that shift understandings of the geographies of the network and the communing of seeds and data?

Impacts of Agricultural Education through Participatory Seed Trials within Community-Based Food Systems at The Evergreen State College

This roundtable features stories of agricultural education, specifically NOVIC field trials, Culinary Breeding Network and Seed to Kitchen Collaborative activities, and students' seeding of community-based food systems at The Evergreen State College. The student whose capstone project demonstrates the agricultural education it was designed to study, will ask: "How often do we consider what food truly means to us? How has the relationship between food and humans shaped the evolution of multiple species and the earth itself?" In what ways has the lack of agricultural education resulted in a world "where the vast majority of people can no longer recognize the products they consume in relation to the constituents of which they are made?"

Voices of assigned authors will echo through student panelists, including those of America's enslaved agriculturists to whom Leah Penniman dedicates Farming While Black: "our ancestral grandmothers … braided seeds in their hair before being forced to board transatlantic slave ships, believing against the odds in a future of sovereignty on land." It is seeds--historically and culturally situated seed breeding, growing, consumption and stories--that provide students a future to believe in against the odds. From NOVIC vegetable trials to CBN's virtual tours of farms, from the seeding of Evergreen's shellfish garden to the seeding of local economies with community-based agricultural cooperatives, this roundtable of students' stories of liberatory agricultural education are offered as "letters from young farmers" to the professional organic seed growers' community.

Panelists (with emails for correspondence) and titles in order of presentation are included here followed by the opening "seed story" by Caleb Poppe, the student whose capstone project not only germinated, but blossomed into this panel.

Dr. Sarah Williams (williasa@evergreen.edu) "Seeds and Syllables"

Dr. Martha Rosemeyer (rosemeym@evergreen.edu) "20 Years of Vegetable Variety Trials at The Evergreen State College"

Caleb Poppe (popcal18@evergreen.edu) "The Inter- and Intra-Personal Impacts of Agricultural Education at The Evergreen State College"

Sarah Dyer (sarah.dyer@evergreen.edu) "Terroir Humaine: Discovering Personal Taste of Place Through Food Studies, Genealogy, and Agricultural Education"

Susan Holcroft (susan.holcroft@evergreen.edu) "Salvaging Our Seed Sovereignty: Appreciation for Indigenous Knowledge and the Growing Movement to Save Seeds for the People"

Casey Chertok (checas25@evergreen.edu) "Seed: The Storyteller"

Ben Bourque (Benvolio.bourque_valente@evergreen.edu) "(In)Authentic: Examining Cultural Rituals and Traditions in Filipino Cooking"

Carli Fox (foxcar26@evergreen.edu) "Excerpts from a Community Garden Journal"

Henry Geria (hdgeria@gmail.com) "Worker Owned Cooperatives as a Potential Model to Mitigate Social and Economic Power Imbalances in Modern Agriculture"

Emily Wilder (Emily.kara.wilder@gmail.com) "Growing Oysters Grows People! Seeding Hope in the Evergreen Shellfish Garden"

Amelia Pressman (preame11@evergreen.edu) "Mussolini and Dionysus as Figures of Cultivation and Insemination: Fascist Italy and the Ancient World"

Adam Smith (adam.m.smith@evergreen.edu) "Citizen Science and the 2021 SURF/NOVIC Tomato Trial"

Zoe Dewitt (zoe.dewitt@evergreen.edu) "Student Leadership and Reclaiming Evergreen's Medieval Herb Garden"

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Student Seed Story #1: "The Inter- and Intra-Personal Impacts of Agricultural Education at The Evergreen State College" by Caleb Poppe

When my capstone supervisor sent me an article about participatory plant breeding and the Seed to Kitchen Collaborative, I felt it was speaking directly to me and my vision for community-based food and ag education at The Evergreen State College. Healy and Dawson state: "[T]here is a strong need to connect agricultural research to social movements and community-based food system reform efforts" (Healy and Dawson 2019: 879). It became my goal to highlight the potential of community-based food systems to be used as a model for an empowering agricultural education that teaches new growers the interconnectedness of progressive social justice movements and regenerative agricultural practices. By converting unused community garden plots into workable soils, we made a space in which I could mentor my peers through a version of regenerative agriculture by actively growing a diverse array of fruits, grains, and vegetables. I also involved students in my shishito variety field trial and tasting labs. We used our time of collective manual labor, tastings, and seminar discussions to tether our experiences to the histories of racial, political, and environmental traumas that persist in our present world, gaining perspective of how these issues are all interconnected. This is the story of how my peers and I planted seeds that grew food and community at the Evergreen State College.

I found I was not alone in my desire to see positive changes take place in both modern food cultures and social-justice movements. As Leah Penniman asserts in Farming While Black, "we are part of an inexorable web of connection that binds our lives to those in our community, nation, and world" (Penniman 2018: 281). I feel fortunate to live in the Pacific Northwest and to have access to incredible soil, a forgiving temperate climate, and a community of people that I consider to be the lifeblood of regenerative agriculture in our region. As a student, I had the auspicious opportunity to connect with likeminded individuals who all have at least one thing in common – a desire to learn. The academic community of the Evergreen State College has always lent itself to an interdisciplinary education that encourages an inclusive, accepting, and environmentally conscious demographic. This interdisciplinary model makes Evergreen an ideal place to collaborate and form ideas for progressive social and environmental changes.

Through my time as an undergraduate at Evergreen, I had the opportunity to conduct numerous agricultural research projects that allowed me to connect with a community of people who understood the importance of seed sovereignty and regenerative agriculture. Through collaborations with the Culinary Breeding Network and NOVIC, I conducted multiple Organic Field Variety Trials at the Evergreen farm, studying numerous varieties of tomatoes, daikon radish, radicchio, and shishito peppers. Over the years, I leapt at the opportunity to educate others about the importance of performative organic plant-varieties that also taste good. In addition, the tasting events that highlighted the produce harvested from the trials effectively connected the agricultural sciences back to eaters, allowing for a way to celebrate the work of organic farmers and breeders alike. It is this movement of community outreach and education towards agricultural research that I found empowering and necessary in the effort of broadening people's understanding of organic food production.

Some part of me is aware that a garden space that boasts diversity, and thus inclusivity, is surely a place where I can express myself. Because of this, I approach agriculture as a form of therapy, a dramatic shift from the common trope of the over-stressed farmer drawn towards madness (Sempik 2010). It is this mentality that I wanted to share with my peers. As we worked, we told stories and confided in each other. For many of us this was the beginning of our reintegration into meeting in-person for class following the initial COVID-shutdown. Everyone had lived a lot of life in a short amount of time. Many of us were simply happy to be outside, surrounded by other humans. Personally, I used these weekly meetings as my time to decompress from the rest of life's demands. We were all coming into this garden with varying degrees of 'baggage,' and so we started slow, meeting each other where we were at. Despite it all, I still heard my peers saying things such as, "I really needed this" or "this is the best part of my week."

There is something magical about eating fruits and vegetables that came from seeds we ourselves place in the ground, and so it was important to me that we started everything directly from seed. We seldom appreciate the full power of the seed, but it is easier done when we can observe a seed no larger than a pebble grow into a full-fledged cabbage bigger than our own heads. I was honored to be using seeds that had been primarily donated by local seed companies. Thank you Osborne Quality Seed! People were quick to offer their help when I told them what I was attempting. It is hard to do this kind of work and not feel intimately invested in its progress. No matter whose vision or crop plan we are following, we growers tend to living beings and are responsible for their health and well-being.

We must not underestimate the power of the seed. It is a symbol for regeneration, for growth, and for hope. When we hold seeds in our hands, we hold the future of generations. Seeds remind us of our homelands, and as in Leah Penniman's writing, seeds signify the rebirth of our lost loved ones. We have created art in which seeds are held up as magical beings, and we have created seed vaults across the globe that hold our world's seed varieties in perpetuity. We have a lot to learn from the power of the seed, through its persistence and patience, for it does not question itself or hesitate when deciding to stand up and act. Much like the seed, there is a significance in offering an empowering agricultural education, especially one that does not view farm management as unrelated to social justice. Leah Penniman argues that we live in a world that depends upon farmers for their work, and thus we have a need to address reparations of the past. If we want a world that widely adopts regenerative agricultural systems, we must plant a seed for progressive reform and socio-political changes, changes that will require support for environmental restoration, social and racial justice, climate resilience, and economic equity. I am inspired by how community-based food systems serve to empower, teach, and connect people of all demographics and cultures through the act of planting and growing seeds and eating nutrient dense delicious foods.

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In The Great Derangement as well as his recent The Nutmeg's Curse, Amitav Ghosh has written about how the narrative structures we use both inform the realities described and render invisible the realities not articulated--but in relation to which our rendering is made meaningful. Caleb, for example, echoing the words of Mark Bittman in Animal, Vegetable, Junk, asks, "In what ways has the lack of agricultural education resulted in a world where the vast majority of people can no longer recognize the products they consume in relation to the constituents of which they are made?" We humans often derive both a sense of knowledge and sensation of pleasure from the act recognition--from re-cognizing circumstances we are unable or unwilling to name, confront, or welcome. Climate Change. Systemic Racism. Inequitable Labor and Land Tenure. Food as Our Most Prevalent Source of Disease or now second to COVID, a Long Overdue Zoonotic Environmental Disease. What can happen when we begin a college course on, for example, permaculture, as my colleague Dr. Steve Scheuerell does, by asking those students in the room to consider those with hands-on knowledge who are not in the room? This panel is about planting the seeds of recognition, like this: Permaculture--like Seed-Saving-- is a more than 10,000 year-old cutting-edge technology and tradition!" What can happen when those interested in food and ag and under 25 (or are "beginners" with less than 10 years of seeding experience) meet up with that majority of farmers over 65 to shift from a globalized system that values how much, how fast, and how cheap to participatory food and ag systems that value how sustainable, how nutritious, and how tasty?

From learning about the role of flavor in in human evolution (which in Dunn and Sanchez's research intersects a much older story of chemical ecology between plants and insects), to learning about the political ecologies of seed sovereignty, cultures, genomic science, and agribusiness, the presenters in this round table demonstrate the intimacy between language and seeds through the liberatory potential of agricultural education. In this virtual experience of the Organic Seed Growers Conference when words replace hands as our common modality for labor and communication, we offer these stories and invite your responses: "How often do we consider what food truly means to us? How has the relationship between food and humans shaped the evolution of multiple species and the earth itself?" In what ways has the lack of agricultural education resulted in a world "where the vast majority of people can no longer recognize the products they consume in relation to the constituents of which they are made?"

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From Seeds to Territories : A Transatlantic Conversation

Maria Carrascosa, la Red de Ciudades por la Agroecología / Red de semillas

Riccardo Bocci, Rete Semi Rurali

Corentin Hecquet, Réseau pour les semences paysannes et citoyennes

Hugo Martorell, SeedChange | Sème l'avenir

Marie-Claude Comeau, Radicle Farm

Introduction

Social movements and networks across the world are committed to agricultural diversification, the preservation of biodiversity and farmer-bred seeds. For some, their goal is to supply local farmers with regionally adapted, organic seeds. This paper builds on the experience of 5 regions : Brittany (France), Andalusia (Spain), Italy, Quebec (Canada) and the transborder network Meuse Rhin Moselle. The goal is to provide a brief overview of the territorial dynamics, and to discuss participatory plant breeding projects with an emphasis on their economic outcomes.

The territorial seed networks presented in this paper work to create a collective dynamic to cultivate and enhance agricultural biodiversity. They play a convening role, bringing together farmers to share seeds and exchange knowledge and know-how. The seed networks aim to maintain and promote biodiversity through community seed banks, annual fairs and seed hubs. These networks play a role in surveying research needs, linking with academic institutions and coordinating participatory plant breeding projects. Farmer-run networks have the added economic function of purchasing and marketing crops. The case studies focus on two general agricultural groups : cereals and vegetables.

Vegetable seed production

The southwest and western coasts are two key regions of vegetable seed production in France. Kaol kozh, in Brittany, is an organic farmer co-op with over 20 years of experience of growing seed and releasing new cultivars. Its focus has been on maintaining cabbage and onion diversity. The last creation was the “bricoli” which answers to the aim of combining good taste (from sprouting broccoli), modern broccoli form (crown) and violet color to be easily recognized by consumers. It is now examining germplasm for other locally-grown crops like radish, leek and carrot. Farmers and gardeners work together to trial and grow out the most promising populations. Kaol kozh created a collectively managed label (*Légumes issues de semences paysannes*) as a way to highlight the labor of its members dedicated to growing seeds.

The Meuse Rhin Moselle Network, located in between Belgium, France and Luxembourg, has focused its work on the territory of *Coeur de Condroz*, where two seed artisans and one seed multiplier are located. The mission of the network is to involve a wider audience rather than a small group of specialists. It has three streams of work: emblematic vegetables, seedling production and, similar to Brittany, a local seed label. The network is promoting 5 iconic vegetable crops of regionally adapted populations : the Rouge sang carrot, the Gros de Liège leek, the Roi des belges bean, the Blonde Laeken salad and the Rouge de Huy onion. Demonstration gardens are being set up to increase their visibility.

The *Rete Semi Rurali* in Italy and *Red Andaluz de Semillas* in Spain are focusing their research efforts on another emblematic vegetable, the tomato. They are currently either studying and characterizing its diversity or creating evolutionary populations (ex: beefsteak type in Italy).

In Quebec, seed packet sales are the driving force of the local seed market. Farmers and seed growers are participating in regional and national trials in a variety of crops, including carrots, melon, spinach, rutabaga, radicchio and tropical eggplants. Yellow dwarf wax beans are next. A smaller group of farms are involved in on-farm selection and breeding. Cross-collaboration and knowledge-sharing have proven to be valuable in this area. Market gardeners have expressed interest in increasing root uniformity on OP varieties by working with seed growers to select roots together at harvest and have the latter bring them to seed the following spring. Farmers have also expressed interest in being more self-reliant with cover crop seeds like hairy vetch, common vetch and black oats. Finally, new seed producers specialized in seed multiplication are playing an important role in increasing supply for local seed companies aiming to keep up with demand.

Cereal seed production

The Triptolème association in Brittany has been involved for quite some time in on-farm breeding projects with the goal of creating evolutionary populations and blends (wheat, rye, etc.). More recently, organic grain farmers are focusing their efforts on buckwheat. The goal is to use selection methods to increase diversity (trials, blends, composite cross populations) and to create evolutionary populations that have the ability to adapt to the specificities of each farm and their respective markets. The second goal of this project is to understand and implement techniques to add value to this crop. In collaboration with the INRAE, farmers are introducing new hulled buckwheat varieties, which differ from the traditional varieties that are processed into flour for pancakes (*galette*). In order to dehusk the grains, farmers are involving the *Atelier paysan* to adapt machines and access affordable material.

The Meuse Rhin Moselle network is also focusing its work on adding value to cereal crops. This means increasing the reach of new supply chains and, over the medium term, building a mill. The financing of the mill (120,000 euros) is a challenge, especially when it comes to accessing capital from the banks. The network is playing a critical role to promote this project and finding individual loans, donations and sponsorships. The network projects that the marketing of multiple, added-value grains into small packets to consumers will be another upcoming challenge.

In Quebec, members of the Coop Agrobio expressed concern with GMO contamination in corn seeds. This issue has led to 10 years of on-farm trialing, selection and seed-saving to guarantee a reliable seed supply. Although some varieties were selected for their color and different uses (flour, popcorn), yields remained too low to convince farmers to grow them. The most recent trials highlighted varieties from Saatbau, an Austrian seed supplier. This has led to a new commercial agreement to import and supply grain farmers with organic, hybrid and GMO-free corn seeds. The construction of a new semolina flour mill, matched with the availability of horned corn varieties from Saatbau, is a promising avenue to add market value.

In Spain, the *Red Andaluz de Semillas* accessed E.U. funds (Diversifood) to work with researchers in identifying and characterizing 12 varieties of local wheat, concluding that they have equal if not higher yields than their modern counterparts. This was a key step before introducing heritage varieties to farmers via community seed banks. In parallel, the *Red de Ciudades por la Agroecología* is another network to engage municipalities on the topic of biodiversity. This network has been helpful in highlighting the work of towns like Granollers, close to Barcelona, which is providing economic and infrastructure support for a community seed bank.

Italy also has a rich experience when it comes to involving local or regional governments. Italy's Common agricultural policy has enabled the Reti Semi Rurali to have multiple cereal projects funded by administrative regions like Sicily, Tuscany, Veneto and Umbria, with a special focus on creating populations and adapted blends of durum and soft wheat. Reti Semi Rurali is also using on-farm selection methods to improve rice, oats, rye, corn, lentils and sunflower cultivars.

Discussion

From a technical and commercial standpoint, the territorial experiences mentioned above raise multiple avenues to increase seed diversity, quality and quantity. In the case of vegetable seeds, supplying farmers is difficult, with the exception of the case of Britany, where farmers are self-reliant for several cultivars. The implementation of regional seed labels, the identification and promotion of regional varieties, the selection of new populations, the creation of seed hubs to provide seed cleaning equipment and to train new farmers are all strategies that have been highlighted. Most importantly, these strategies need to be combined with farmers producing seeds for their own use and to exchange them with other farms. Over time, some farms will tend to focus on certain species and therefore increase broader seed availability.

For cereals, one commonality with on-farm breeding projects is their work on blends and evolutionary populations. A common challenge is access to specialized equipment like seeders and combines for micro plots, appropriate screening equipment, storage space, as well as machines for husking and grinding grain and adding value to by-products. This is especially relevant for protein crops (e.g. yellow peas, sunflowers). The contribution of groups such as the *Atelier paysan* in France seems particularly rich with regard to adapted equipment. Several contributors concluded that the challenge is to establish collective economic models, to access investments and to reach citizen markets (e.g. AMAP, CSA), local markets or niche markets.

Breeding and adaptation require recovering and creating traditional know-how that is no longer transmitted from generation to generation. The major challenge for the territorial seed network remains maintaining their activities, which have been dependent for many years on research projects financed for limited periods of time. Even if funds end up succeeding each other over time thanks to the contribution of various funds (European, national, or regional), it is critical to think about the sustainability of support for research, breeding and knowledge transfer on organic farms and among farmers for whom these activities are added to those of producing and marketing their crops.

Texte intégral en français : Des semences aux territoires : une conversation transatlantique.

Introduction

De nombreux réseaux à travers le monde sont engagés dans la diversification agricole, la préservation de la biodiversité et le renouveau des semences paysannes. Plusieurs visent, à terme, à pallier le manque de variétés biologiques et régionalement adaptées à l'échelle de leur territoire. Ce texte s'inspire des initiatives dans 5 régions : la Bretagne, l'Andalousie, l'Italie, le Québec et le réseau transfrontalier Meuse Rhin Moselle. Il a pour objectif de dresser un bref portrait des dynamiques territoriales. Le texte souligne les travaux de recherche et développement qui mobilisent les agriculteurs dans des schémas de sélection génétique décentralisés. Enfin, le texte aborde le thème des débouchés économiques des semences paysannes et les défis qui en découlent.

Les réseaux étudiés oeuvrent principalement à créer une dynamique collective de valorisation de la biodiversité agricole. Ils jouent un rôle rassembleur qui valorisent les savoir-faire des agriculteurs et facilitent les échanges de connaissances et de semences. Ils sont impliqués dans des projets variés pour conserver et promouvoir la biodiversité via des banques de semences, des foires annuelles et des Maisons de semences. Ces réseaux animent des groupes de travail et s'impliquent dans des projets de recherche et développement. Les réseaux d'agriculteurs, quant à eux, ont en plus un rôle économique d'approvisionnement et d'écoulement de denrées. Les réseaux travaillent sur des cultures variées, mais dans l'ensemble, ils se concentrent sur deux grands groupes agricoles, les plantes maraîchères et les cultures céréalières.

Les plantes maraîchères

En Bretagne, Kaol kozh est orientée sur la création et la production de semences d'espèces légumières avec une grande expérience depuis les années 2000. Même si l'association a commencé par sauvegarder la diversité des choux et des oignons pour être au plus près des principes de l'agriculture biologique en matière de méthodes de sélection, elle continue à explorer des ressources génétiques d'espèces légumières produites localement (radis, poireaux, carottes …). Les paysans et jardiniers s'organisent collectivement pour évaluer et multiplier les populations les plus intéressantes. Kaol kozh a initié une expérience de valorisation du travail sur l'origine de la semence des légumes vendus auprès des consommateurs avec la mise en place d'une mention (« Légumes issues de semences paysannes ») gérée et certifiée collectivement par les membres de l'association.

Le Réseau Meuse Rhin Moselle, aux confins de la Belgique, la France et le Luxembourg, quant à lui, concentre ses efforts sur le territoire du Coeur de Condroz, ou deux artisans semenciers et un multiplicateur sont présents. Le Réseau a constaté que le dossier semences demeure confiné à un petit cercle de spécialistes et estime que sa mission passe par l'implication d'un large public. Les trois axes de travail du Réseau sont : les légumes emblématiques, la production de semis pour les maraîchers et, inspiré par les démarches de Kaol kozh, une mention valorisante des semences locales. Le Réseau a choisi 5 espèces légumières issus de variétés-populations adaptées au territoire afin d'en faire la promotion comme légumes emblématiques : le carotte Rouge sange, le poireau Gros de Liège, le haricot Roi des belges, la salade Blonde de Laeken et l'oignon Rouge de Huy. Des jardins de démonstration seront aménagés pour les mettre en valeur. La Rete Semi Rurali en Italie et la Red Andaluz de Semillas en Espagne semblent concentrer leurs efforts de recherche sur un légume-fruit vedette, la tomate, via des projets de caractérisation et de sélection de populations évolutives (ex: type Cœur de bœuf en Italie).

Au Québec, la vente au détail auprès des jardiniers est le moteur de cette filière. Malgré des fournisseurs dans le nord-est des États-Unis, le défi principal est le manque de disponibilités de variétés à pollinisation libre produites localement dans les formats et les standards de qualités attendus des maraîchers biologiques et diversifiés. Les multiplicateurs de semences biologiques jouent un rôle important pour approvisionner les compagnies de semences locales, qui ont besoin de fournisseurs supplémentaires pour répondre à la demande. La co-sélection des légumes-racines entre agriculteurs et semenciers est une autre stratégie prometteuse pour intégrer les critères des fermes biologiques. Sur le plan collectif, les membres de la Coopérative pour l'agriculture de proximité écologique participent à un projet pour développer un réseau d'essais de variétés (carottes d'entreposage, melon d'eau, épinards, haricots jaunes) et se penchent sur la multiplication de semences d'engrais verts (vesce commune, vesce velue et avoine rude).

Les céréales

L'association bretonne Triptolème s'implique de longue date dans des projets de populations évolutives et de mélanges de blé paysans (blé, seigle, etc.). Plus récemment, les paysans des réseaux de l'agriculture biologique, coordonnés par la FRAB (Fédération régionale de l'agriculture biologique), développent un projet sur le sarrasin qui explore à la fois (1) les méthodes de sélection pour élargir la diversité (évaluation de ressources génétiques, mélange, population composites) pour créer des populations évolutives capables de s'adapter aux particularités de chaque ferme et son marché et (2) les aspects techniques de valorisation du produit. Avec le groupe de recherche BCRP (Biodiversité cultivée et recherche participative de INRAE), des variétés capables d'être décortiquées en parallèle de la production de farine (pour la traditionnelle galette bretonne) sont en voie d'être introduites. Le sarrasin décortiqué est un produit nouveau pour la région. Les participants du projet doivent innover en parallèle sur le machinisme avec un autre réseau, l'Atelier paysan, pour créer ou adapter des machines et rendre abordable le matériel nécessaire à une production de qualité à la ferme.

La valorisation de produits céréaliers a aussi été jugée prioritaire par le Réseau Meuse Rhin Moselle, qui démarre une filière de céréale panifiable dénommée « des semences au pain » et vise à terme l'implantation d'un moulin. Pour le financement du moulin (120,000 euros), l'agriculteur a développé un plan de financement. La difficulté est de justifier le projet auprès d'une banque à partir du moment où l'agriculteur n'a pas de contrat d'achat pré-signé avec les boulangers du fait que les boulangers attendent la farine pour en acheter. Dès lors, le RMRM a facilité la recherche de personnes prêtes à réaliser un prêt interpersonnel ou un don. Ensuite l'enjeu va être sur la promotion du produit auprès des boulangers, des clients, et envisager la commercialisation de petits paquets à destination de particuliers d'une diversité des produits (farine de froment, d'épeautre, issu de « blé anciens »).

Au Québec, la Coop Agrobio était préoccupée par la contamination OGM dans les semences de maïs pour l'alimentation humaine et animale. Les essais conventionnels de maïs en station de recherche ne convenaient pas aux objectifs de la coop, qui a commencé à évaluer des variétés à la ferme et sélectionner celles de différentes couleurs et pour différents usages (farine, popcorn). Les rendements des semences issus des sélection à la ferme demeurent inférieurs à ceux des hybrides et il a été difficile de convaincre les membres. Les dernières itérations des essais de maïs bio ont fait valoir un fournisseur autrichien, débouchant sur une entente d'importation et de distribution de semences hybrides biologiques. Un projet de construction d'usines de semoule de maïs est en voie de s'arrimer avec les membres de la Coop Agrobio et les semences de variétés cornées de Saatbau. Du côté de la Coop des Hautes Laurentides, l'accès à un cribleur de petites semences est jugé prioritaire.

En Italie, la Reti Semi Rurali est impliquée dans plusieurs projets de sélection avec des groupes locaux d'agriculteurs dans le riz, le blé dur et le blé tendre, l'avoine, le seigle, le maïs, les lentilles et le tournesol. Les projets de recherche sont financés par les régions sous la Politique agricole commune italienne, dont la Sicile, la Toscane, Veneto et Umbria, et visent la sélection de populations et de mélanges adaptés de blé. En Espagne, la Red Andaluz de Semillas a mené un projet de caractérisation de 12 variétés locales de blé. Sur le plan municipal, la *Red de Ciudades por la Agroecología* met en valeur des expériences comme celle de Granollers, près de Barcelone, dans l'appui économique et l'accès à des infrastructures pour la construction de banques communautaires de semences.

Discussion

Sur le plan technique et commercial, les expériences territoriales soulèvent plusieurs pistes de réflexion. Du côté des semences potagères, l'approvisionnement des maraîchers professionnels est jugé difficile, à l'exception du cas breton, où les agriculteurs s'auto-approvisionnent pour plusieurs populations. La valorisation et l'animation des savoirs agricoles, ainsi que les projets de caractérisation et d'essais de variétés, peuvent être combinées avec des démarches d'autoproduction de semences et d'échanges entre les fermes dont certaines privilégient des espèces en vue d'augmenter la disponibilité. La création de mentions valorisantes, l'identification et la promotion de variétés locales et patrimoniales, la sélection à la ferme de nouvelles populations, la création de Maison de semences paysannes pour disposer de matériel de nettoyage et de tri des semences et pour former de nouveaux maraîchers sont autant de stratégies soulignées.

Du côté des céréales, une piste consiste à combiner la culture de populations paysannes avec l'accès à de l'équipement spécialisé comme des semoirs et des batteuses pour des micro parcelles, des trieurs pour les semences, des espaces d'entreposages ainsi que les machines pour décortiquer et moudre le grain et valoriser les sous-produits. Ceci est d'autant plus pertinent dans les protéoléagineuses (ex: pois jaune, tournesol). La contribution des groupes comme l'Atelier paysan en France semble particulièrement riche à l'égard d'équipements adaptés. Plusieurs intervenants concluent que le défi est d'établir des modèles économiques collectifs, d'accéder à des investissements et atteindre des marchés citoyens (ex : AMAP, ASC), des marchés sur un territoire ou des marchés de niches.

Le défi majeur à relever demeure la continuité des activités d'animation au sein des associations qui sont dépendantes depuis de nombreuses années des projets de recherche financés sur des durées limitées. Même si les financements se succèdent dans le temps avec des fonds variés (européens, nationaux, ou régionaux), il devient nécessaire de penser à une pérennisation du soutien à la recherche et la sélection sur les fermes biologiques et chez les paysans pour qui ces activités s'ajoutent à celles de la production. L'activité de sélection nécessite de retrouver ou créer des savoirs qui ne sont plus transmis de génération en génération avec les semences. Par ailleurs, il est difficile, pour financer la recherche, d'augmenter les prix des produits issus de semences paysannes pour aller vers un public de plus en plus large.

Policy Overview and Recommendations for Organic Seed Breeding in an Era of Climate Change

Cathy Day, National Sustainable Agriculture Coalition

Organic seed breeding, like the rest of agriculture, faces substantial challenges in an era of climate change. The last farm bill created some changes in seed breeding policy that will address some of the needs of organic seed breeders in facing such challenges.

Among the changes in the last farm bill were alterations to the National Genetics Advisory Committee that allow for broader participation from the larger breeding community. In addition, the U.S. Department of Agriculture's National Institute of Food and Agriculture (NIFA) has made changes to its grant programs that affect organic seed production.

Over the years NSAC urged USDA's Agriculture and Food Research Initiative (AFRI) to distinguish between applied and basic plant breeding research to ensure an even distribution of funding and outcomes cross the discipline. The Foundational program has since made distinct plant breeding project requests that delineate basic plant breeding research (pre-breeding, germplasm enhancement, genomics, and phenomics, etc), and later stage cultivar development (testing and evaluation of regional traits). Further, there is an additional investment for plant breeding projects that are in partnership with minority-serving institutions.

With the challenges posed by a changing climate, producers need resilient and adaptive plant breeds that can withstand drought, heat, and even flooding and disease, weed pressure, and other stresses. Producers also need cultivars that can perform well in organic and other low-input sustainable production systems that protect soil health, natural resources, environmental quality, and climate stability. This is essential to safeguard our long-term food security. Yet, overall, there has been a decline in national public plant breeding investments which threatens long-term sustainability of our food system and efforts to build resilience. According to a 2020 study, plant breeding programs in the U.S. face budgetary and personnel challenges that "endangered or severely constrained" plant breeding research (Coe et al., 2020). Others have previously noted that "plant breeding in the public sector is in a current state of crisis because of a lack of sufficient funding to support this public good" (Shelton & Tracy 2017).

Stakeholder participation is key in shaping climate policies for the future. Organic breeders and farmers will be important advocates in creating policies that ensure publicly accessible seeds for resilience to a range of weather impacts. In addition to offering an overview of the current status of seed breeding policy in the United States, the presentation will offer some key points of advocacy in which members of the organic seed community should engage.

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Breeding Barley for Organic Systems

Brigid Meints, Department of Crop and Soil Science, Oregon State University

Karl Kunze, School of Integrative Plant Science, Plant Breeding and Genetics Section, Cornell University

Chris Massman, Department of Agronomy, University of Wisconsin – Madison

Cristiana Vallejos, Department of Crop and Soil Science, Oregon State University

Introduction

Organic growers need new crops, markets, and rotation options supported by varieties that are developed specifically for organic conditions. Currently, organic barley end-uses and markets are stratified due the presence of an adhering hull and grain β-glucan content. This OREI-funded research is focused on breeding naked (hull-less) varieties that have potential environmental and economic benefits for organic producers. The researchers are breeding for naked barley with modest levels of β-glucan to create varieties suitable for brewing, feed use, and that will meet FDA guidelines for soluble fiber in human diets. Traits that have been identified as being especially important for multi-use barley grown in organic systems include resistance to smut (both covered and loose), early plant vigor and ground cover, resistance to embryo damage (important for plant vigor in the field, malt quality, and sprouting for food and feed), kernel hardness, and threshability. Development, assessment, and breeding of naked multi-use barley is being conducted in five representative regions/states – West Coast (OR, CA), Upper Midwest (MN, WI) and North East (NY) - using four classes of germplasm assessed under organic conditions: a naked barley blend targeted to K-12 students and gardeners, a large diversity panel to apply genetic data to improve barley for organic systems, a modified nested association mapping panel developed as a breeding population targeting traits important for organic systems, and a multi-regional trial to identify varieties for release. Agronomic, food, feed, malting, and brewing performance is being evaluated in the organic trials.

Currently, there is fragmentation in barley production due to the presence/absence of hulls and variation in β-glucan level. Farmers seeking the malting price premium grow varieties with hulls because in the US most brewers are not equipped for or familiar with naked barley malts. If their malting barley is not sold for malt, they are forced to sell at lower food or feed prices. Conversely, a food barley grower may not have a sufficient market for naked grain that could otherwise make an excellent malt or feed. If s/he is producing a high β-glucan naked waxy starch variety for food, it will be unacceptable for malting/brewing and feeding. A lack of familiarity with naked barley complicates marketing the crop to the food industry, feeders, and users of malt. This project is directed at discovering paths to create accepted multiple uses for organically-grown barley varieties. This goal will be most readily accomplished by plant breeders developing and releasing naked multi-use varieties with modest β-glucan levels suitable for organic production. At the same time, food processors, feeders, and maltsters/brewers need to be familiarized with the newly available naked varieties and their advantages. Given their strong interests in innovation, health, and sustainability, the organic production, processing, and consumer communities stand to benefit directly from the adoption of multi-use barley varieties.

Screening and Breeding for Smut Resistance

Due to the effectiveness of conventional fungicidal seed treatments, breeders in the United States have not targeted smut resistance in their development of new cultivars in several decades. Loose smut (*Ustilago nuda*) and covered smut (*Ustilago hordei*), which are both seedborne diseases with different infection mechanisms, have been identified as significant problems in organic production. There has been some research looking at organic seed treatments, which can be effective against covered smut, but currently there are no approved products. Organic farmers would greatly benefit from cultivars bred for genetic resistance.

Breeding for smut resistance is resource intensive. Phenotyping for covered smut takes 2-3 months from inoculation to symptom development. Loose smut is even more intensive to phenotype for because plants must be grown to flowering, inoculated, seed harvested, replanted, and grown to heading to assess symptoms. In screening for both diseases, there is the possibility of inconsistent infection, escapes, and false positives- all of which require repeat screenings to be conducted. Additionally, inoculation of naked barley with covered smut spores can result in poor emergence or emergence of distorted seedlings that do not flower.

In this study, 384 naked barley genotypes were inoculated with covered smut spores collected in the field the following season. Five plants of each genotype were grown out in the greenhouse and incidence of disease recorded. Preliminary genome-wide association studies (GWAS) revealed a potentially novel resistance gene on 3H. Researchers are currently working on further inoculation studies and will then work to validate the novel QTL, which could be useful for marker assisted selection.

Examining Weed Competitive Ability with Aerial Imaging

In organic systems, competition from weeds often reduces barley yields and is a serious impediment for farmers transitioning from conventional to organic production. Higher grain yields can be obtained by selecting varieties that can effectively tolerate or suppress weed growth and through breeding barley varieties for increased weed competitive ability (WCA). However, measuring WCA is difficult because of genotype by environment interactions and low heritability. Consequently, it is necessary to use a combination of correlated traits to indirectly assess and select barley genotypes that have superior WCA. WCA describes ecological interactions between weeds and crop plants and can be measured as weed suppression or crop tolerance. Weed suppression is measured as the reduction of weed growth or seed production in comparison to a weed-free control, while crop tolerance is measured as the absolute yield or the percent yield loss under weedy versus weed-free conditions.

Crop competition with weeds will be an essential trait to accurately measure in organic breeding systems. However, given the large effect of the environment and management decisions on weed pressure and genotypes it can be difficult to accurately assess weeds in a repetitive experiment. In addition, assessment of weeds by visual estimation alone can lead to subjective measures that do not accurately quantify the weed pressure in each trail. One method to quantify crop weed competition is to measure growth rates of the crop in organic systems is to utilize aerial imaging methods which take images that capture variation more accurately than visual assessment alone. Here, we present aerial imaging results of organic spring naked barley yield trials at two locations over two years. Aerial imaging was conducted at 7 timepoints in 2019 and 8 timepoints in 2020. Images were taken using a RedEdge Mica sense camera and images processed using OpenDroneMap and Imagebreed, part of the Breedbase data system.

Genomic Prediction of Threshability in Naked Barley

Ease of hull removal, or 'threshability', has been identified as an important trait to select for in naked barley because grain with undetached hulls mixed in with naked barley can lower the quality for multiple end-uses. While threshability is a defining characteristic of naked grains and has been found to be related to grain size and shape, its genetic architecture is poorly described. This study was conducted to identify quantitative trait loci (QTL) associated with threshability and test their utility as covariates in genomic prediction (GP). A genome wide association study (GWAS) identified two loci on chromosome 2H and 3H respectively associated with threshability. The locus on chromosomes 2H accounts for 9.9% of the phenotypic variance explained (PVE) in the spring panel. The locus on chromosomes 3H accounts for 7.9 of the PVE in the fall panel. With effects on threshability of -0.18 and -0.29 respectively, these markers could be useful in marker assisted selection (MAS). Predictive ability for threshability was 0.84 using genomic best linear unbiased prediction (gBLUP). Incorporation of the markers with significant associations as covariates did not improve predictive ability. Likewise, predictive ability was not improved by the inclusion of grain test weight, percentage of thin grains, or percentage of plump grains as covariates in the gBLUP model. The presence of QTL was significantly associated with threshability, as well as the high predictive ability for threshability overall indicate that either MAS or GS would be useful in selection for threshability.

Developing New Germination Protocols for Naked Barley

The American Society of Brewing Chemists (ASBC) "Methods of Analysis" were developed to "improve and bring uniformity to the brewing industry on a technical level" and provide standardized methods for each step of the brewing process. These methods have primarily been developed using covered barley, the primary source for malt, but interest and breeding efforts for naked barley have dramatically increased due to potential benefits (i.e., fewer off-flavors, reduced spent grain, higher extract levels).

Because of the lack of hull, naked barley suffers higher embryo damage instances than its covered counterpart. This is important for both malting and barley produced for seed. Organic systems require excellent germination in the field so the barley can compete well with weeds. While macro-damage (visible embryo damage or loss) may easily be evaluated, micro-damage (non-visible fractures) may not be. Preliminary results have shown that seeds with potential micro-damage may still chit during the ASBC method of germination and therefore be counted as "germinated" but will not produce viable roots or shoots. An alternative to the ASBC method is the ragdoll method, where seeds are germinated for a longer period of time, typically 5 to 7 days, allowing for further growth of the roots and shoots, thus giving a better idea of the actual germinative energy of the seed.

This study focuses on the ASBC Barley Method 3: Germination, which evaluates germinative energy, capacity, water sensitivity, and its application for naked barley compared to ragdoll germination. As naked barley becomes more popular for malt production testing, developing and modifying protocols to provide the most accurate quality predictors is necessary. This experiment is nested within a larger study aimed to better understand steep and germination protocols for naked barley and includes seven naked barley genotypes and one covered barley.

Conclusions

These completed and ongoing research projects looking at disease resistance, weed competitive ability, threshability, and resistance to embryo damage in multi-use naked barley will allow breeders to select for high quality varieties that perform well in organic systems.

Rocky Mountain Heritage Grain Trials: Grassroots Research to Identify Grains of the Past for Food Systems of the Future

Lee-Ann Hill, Rocky Mountain Seed Alliance

Summary

Since 2016, Rocky Mountain Seed Alliance (RMSA) has been working with a grassroots network of nearly 200 grain growers in diverse locations throughout the Western US, and beyond, trialing over 250 varieties of ancient and heritage cereal and alternative grains. Through the grassroots trials, the 20 most adaptive and resilient varieties of wheat, barley and rye were identified and further assessed in organic farming systems through a randomized, replicated block design at four research sites. Data on field performance and yields was collected, and lab analyses were conducted on grain quality and baking performance. Seed for these varieties was scaled up through the project and offered to growers and farmers freely in the spirit of the Seed Commons.

Introduction

Farmers in the Rocky Mountain West region are facing pressures from climate change including shorter seasons, diminishing water supplies, and increased pest and weed pressures. Economic instability and degraded ecological health due to changes in farming practices present additional concerns for the security and resiliency of regional food systems. Local food movements offer powerful responses to these challenging conditions. As small farmers shift toward sustainable, localized food production, older crop varieties and traditional growing practices are gaining favor—including a return to heritage and ancient grains.

Grains are a highly adaptable and compelling crop for Rocky Mountain farmers seeking to localize food production, especially in unpredictable, hotter and drier climates. Consumers are becoming more interested in ancient and heritage grains with heightened nutritional profiles and better flavors. The Rocky Mountain Heritage Grain Trials project was launched in 2016 with the goal of identifying and trialing ancient and heritage grain varieties for new, resilient local grain economies. The project was designed to use citizen science for assessing and adapting grains. Crowdsourcing allowed for broad data collection through trials of multiple varieties across varied ecological zones and production scales, with a focus on conditions found in the Rocky Mountain West.

To begin, we reviewed historical lists of popular grains grown in the Rocky Mountain region before World War II to identify potential varieties. Additional varieties were suggested by regional heritage grain growers. Seed stock was sourced from the Germplasm Resources Information Network (GRIN) when it could not be procured elsewhere.

The number of grain varieties and trialists grew exponentially alongside the seeds themselves. Our initial growing season of 2016 involved 25 wheat trialists growing a total of 27 varieties of landrace and ancient wheats. In that first year, ten of the trialists returned seed from 21 of the wheat varieties, thus starting the seed increase from single packets of 50 seeds to several packets for circulation in the next year. From there, the project expanded to include 262 varieties of grains and pseudo grains in circulation, and included 195 participants primarily from the

Mountain West, though also from around the globe. Trialists operate at scales from backyard garden plots to small farms up to 30 acres.

In 2020, we added a research component to focus on the "Top 20" varieties, through continued grassroots trials and at four research sites conducting replicated block design trials. We assessed the marketability of the grains through field data, grain quality testing, and baking evaluations.

Objectives

1. Identify and collect qualitative and quantitative data on 20 grains that are adaptive, resilient, and marketable (based on grain quality, and field and kitchen performance) in the Mountain West to determine which varieties are best suited to support regionalized grain economies

2. Increase regionally adapted seed of these varieties, with a target of having at least 20 pounds of each variety available as foundational seed stock for farmers and growers in the Western US.

Methodology

Research methods and experimental design were co-developed with farmer collaborators who cultivated (40) 32ft x 4ft plots with 1 ft between-plot buffers. Total area of the study at each site was approximately 0.15 acres. The experimental design is an augmented design with replicated blocks consisting of three rows each, distributed across the field allowing five cultivars to be grown in replicates for estimation of variance, while the remaining 15 plots were assigned an unreplicated cultivar. Varieties were planted at 4 inch in-line spacing and 12 inch between-line spacing for ease of cultivation and because generous spacing is recommended for older cereals (Rogosa, 2016).

Analysis of both yield and plant height at harvest supported equal variance among the cultivars. This design was recommended because it simplifies the experiment compared to a completely replicated design, while working within a reasonable assumption of equal variation across all cultivars within each site. The purpose of the design was to test hypotheses comparing yield and plant height among all 20 cultivars. The design and field map with coding for randomizing cultivars to plots was created by a research collaborator.

Plant height data was collected in the form of pictures taken with a yardstick and integrated into a data sheet. Yield data was collected after harvest and cleaning of the grains. Qualitative assessments of weed suppression, lodging, vigor, pest, and disease tolerance was also requested of trialists.

Additional bioregional quantitative lab testing was conducted to assess grain quality from each variety per site for moisture content, test weight, 1,000 seed count, falling number, and protein content. Wet gluten and gluten index data was collected on each wheat sample and a pup loaf analysis was done on each variety. Stalk nitrogen testing was conducted on samples from the participating research farm and the Colorado State University – Southwestern Colorado Research Center (SWCRC) in Yellow Jacket, CO. SWCRC also conducted a seeding rate trial that will help address the question of best seeding rates for these unique grain varieties.

Alongside the formal research, we continued our grassroots trials on these varieties with growers who self-selected varieties of interest, and through a SeedLinked project. Participants were sent a randomized selection of wheat, and a full suite of the barley options, including Excelsior barley, which was omitted from the research trials as it fell short of performance standards, and stock was limited. Results were tracked on the SeedLinked platform.

We also offered kitchen trials with five of the varieties that we were able to acquire as flour and as a whole grain option for millers including Einkorn, Emmer, Sonoran White Wheat, Red Fife, and Khorasan. We had 44 participants, including 4 professional bakers. These trials were primarily qualitative, asking participants which varieties they liked best and why. In the kitchen trials, we asked for data on crumb, crust, volume, flavor, and overall performance.

In the grassroots trials, data was harder to acquire and quantify from the majority of trialists, however, many trialists were deeply engaged in sharing their observations and results. Included in our proceedings (see below) and our presentation are a group of trialists who were diligent about their record-keeping and data sharing, and have incorporated their experience and outcomes into a greater project that is supporting a regionalized grain economy in New Mexico (see www.riograndegrain.com).

A final component to the project is an enterprise budget specific for heritage grain production. This enterprise budget will be created using data from farmers who currently grow heritage grains. A Colorado State University agriculture extension agent and agriculture business management specialist will work directly with farmers to create the enterprise budget that will help farmers evaluate the costs and potential profitability of producing heritage grains. The enterprise budget will include costs associated with dehulling equipment, transportation to markets both locally and regionally, and costs of transitioning from conventional grains, vegetable production, and/or integrating grains into current farm practices.

Results and discussion

Data is still being compiled and analyzed, and will be available in the forthcoming Heritage Grain Guidebook, which will be freely available on the Rocky Mountain Seed Alliance website (www.RockyMountainSeeds.org). Yield results and qualitative data have been assessed. Varieties in the trials are listed here from highest yielding to lowest in pounds per acre, with moisture rates incorporated in the calculations. This order also generally reflects weed and pest pressure resistance.

1. Sangaste rye	8. Red Fife*	15. Arabian blue barley
2. Spelt	9. Pacific Bluestem*	16. Pima Club
3. Black Emmer	10. Tibetan purple barley (winter trial)	17. Ethiopian blue-tinged emmer
4. Marquis	11. Khorasan	18. Purple dolma*
5. Turkey red winter wheat	12. Emmer	19. Rouge de Bordeaux*
6. Sonoran white wheat	13. Sin El Pheel	20. Einkorn
7. Iraq durum	14. Black einkorn	

*Limited regionalized seed stock at the onset of the trials of Rouge de Bordeaux, Red Fife, Pacific Bluestem and Purple Dolma barley prevented trialing those varieties at each of the four sites, though each of the varieties was tested at a minimum of one site.

The yield analyses and the qualitative observations from the research trials reflect results from the grassroots trials. Challenges are also consistent between the research and grassroots trials with weed suppression as a key data set and setback for growers who are reporting more weed competition along with more pest pressures. Einkorn and Tibetan purple barley were significantly impacted by weeds to the point of crop failures, though winter plantings of Tibetan purple barley and black einkorn offered enough of a "head start" on the weeds to result in a successful harvest. Einkorn is notoriously slow in germination so weeds generally outpace the growth of this variety. The Tibetan purple barley, while much quicker to germinate, is shorter in stature and thus is also often outpaced by competing plants. And the hulled varieties (spelt, emmer, and einkorn) have the additional challenge of needing specialized equipment for dehulling, which adds time and cost considerations to the final product.

Pup loaf analyses were conducted on all wheat varieties, and the results between varieties were surprisingly similar despite varying gluten and protein contents. However, the tests were based on conventional loaf standards using yeast rather than artisan breads using sourdough, which is likely the more common bread application for these specialty grains. Data is available from the trials on gluten strength, volume, flour and crumb character, and other factors that bakers may find helpful and translatable for their own purposes. All in all, the pup loaf analyses also reflected our grassroots kitchen trials, which involved professional and at-home bakers.

As for our objective to increase seed stock, we were able to increase and share seed stock, though with many plots failing to reach harvest due to weed competition, and with the amount of seed required for the lab analyses (approximately 6 pounds per variety), not all varieties yielded 20 pounds of seed.

Conclusions

Final conclusions are forthcoming with the final data assessments, and will be incorporated into the Heritage Grain Handbook. Preliminary conclusions suggest that the top 5 varieties above are most adaptive and resilient in the field, best yielding, and best performing against weeds and pests. Among the bakers that provided feedback, the grain that ranked highest for flavor and sourdough bread performance was emmer. Professional bakers showed an additional interest in

Khorasan, rye, and durum as localized products, along with interest in local Sonoran White and Turkey Red wheats, though those varieties are available in the greater Western region at a price that would likely be more competitive from larger regionalized growers than smaller local growers. Through a casual survey of professional bakers who were milling their grains, the price point for local grains was $2 per pound for clean whole grains. The enterprise budget analyses will help determine the feasibility of the market. In conclusion, through the project's preliminary results and related discussions with bakers and farmers, the top 5 varieties are worthwhile considerations for growers who are interested in local grains and local grain economies.

Seed Endophytes, Rhizophagy, Nutrient Density, Nitrogen Efficiency and Fixation in Corn

Walter Goldstein, Mandaamin Institute

James White, Rutgers University

Funders for the Mandaamin Institute work include USDA-NIFA-SARE and OREI, Ceres Trust and others.

Cereal crops, including corn, have been bred to produce high yields in conjunction with inputs of soluble nitrogen (N) fertilizers. However, N fertilizers cause pollution of surface and ground water with nitrate and produce a potent greenhouse gas, nitrous oxide. The problem is generally regarded as intractable within the present social/political context. The Mandaamin breeding program represents a long-term effort to breed corn adapted to the needs of organic farmers. This includes breeding for corn that is better able to obtain N from soil and air in order to reduce nitrification and to prevent economic and environmental problems with N fertilizers.

In this presentation we will a) describe the Mandaamin breeding program and its early results including studies in three states together with the University of Illinois and University of Wisconsin-Extension, b) research done by Rutgers University with bacterial endophytes and how that work helps explain results from the breeding program; and c) how practical questions are being answered regarding the usefulness of the cultivars developed by the breeding program.

The Breeding Program

Mandaamin Institute's breeding methods employ a field-based phenomenological approach to breed and select fit, whole bodies for improved inbreds and populations. The institute utilizes pedigree-based inbreeding. Breeding has taken place for 51 seasons under biodynamic conditions in Wisconsin USA, on an organic and biodynamic winter nursery in Puerto Rico, and Hawaii, and conventional winter nurseries in Chile. Crosses are made between landraces or teosinte with adapted inbreds to reintroduce valuable traits. Early-generation-testing is carried out to determine grain yields in hybrid combinations. Selection criteria include protein quality, carotenoid content, vigor, competitiveness with weeds, grain yields, and nitrogen (N) efficiency/N_2 fixation.

Mandaamin Institute's timeline, milestones, and cooperators are as follows. The program began in 1989 and for 14 years created open pollinated populations for farmers. In 2002 breeding began to produce inbreds and hybrids together with USDA-ARS. From 2004 to 2007 it was confirmed through experimentation that N efficiency and soft kernelled seeds with elevated methionine and trace minerals were emerging in multiple populations and inbreds (USDA-ARS, Iowa State University). In 2009 N_2 fixing landraces were discovered and the work began to breed the trait into adapted varieties. In 2018 trials began with the University of Illinois in three states. In 2020 seed-borne bacterial endophytes were found to be colonizing roots and being excreted out of root hairs in Mandaamin Institute's varieties (Rutgers University). Also, in 2020 Mandaamin Institute's first commercial hybrids were sold by a cooperating seed company (Foundation Organic Seed). In 2021 Mandaamin Institute's first commercial hybrids with a putative N_2 fixing parent will be sold.

Results

The program resulted in inbreds and hybrids with greater adaptation to nutrient-and weed limited organic/biodynamic conditions, competitive yields, increased N efficiency and grain nutritional quality and softer grain texture. There is often more chlorophyll in foliage, rhizophagy, densely branched root growth in the topsoil, larger tassels, and greater phenotypic and genomic plasticity than for conventional inbreds. Part of Mandaamin Institute's nutrient efficiency is due to inbreds with broad, fibrous rooting systems adapted to extracting nutrients from soil.

Yield trials have been carried out at the Institute and in conjunction with organic farmers and the University of Wisconsin-Extension. There are generally similar grain yields for Mandaamin Institute's top yielding hybrids as with commercial maize. Somewhat lower yields under high input conditions, but often higher yields under low N input conditions.

Three State Trials

Trials were carried out in conjunction with the University of Illinois in IL, IN, WI on organic farms under mostly manure fertilized conditions Two regions, Central Corn Belt (IL, IN) and Northern Corn Belt (WI). There were 13 farms per year, two years (2018, 2019), unreplicated strip trials on each farm, two Mandaamin hybrids on each site. These hybrids were 17.C46 with a relative maturity (RM) of 105 days, and 17.C2B2 with a RM of 110 days. High yielding commercial hybrids served as checks. Grain was harvested for yield and analyzed at the University of Illinois in Urbana-Champaign, Iowa State University Grain testing lab, University of Wisconsin, and by a commercial lab. The data were analyzed using analysis of variance with main factors being regions and hybrids and with farm sites as replicates. Where differences between hybrids were statistically significant, we compared them with t-tests.

Results

The difference in yield between the hybrids were not statistically significant. However, the 17.C46, which was the earliest maturing hybrid, yielded less in the fuller season, Central Corn Belt sites and the 17.C2B2 averaged 10% less yield than the checks over all sites. The Mandaamin hybrids had lower test weights and seed density because they are softer textured Mandaamin Institute's corns.

The two Mandaamin hybrids had 10 and 18% more protein, 32% more oil, 44 and 63% more zeaxanthin, 48 to 150% more β-cryptoxanthin, 38 to 65% more β-carotene, 10 and 15% more lysine, 33 and 42% more methionine, and 10 and 16% more cysteine in their grain than did the commercial checks. These differences were all statistically significant at the 95% security level. They also had 23 to 25% higher methionine contents in their protein than did the checks. Furthermore, mineral analysis revealed that the Mandaamin hybrids had 17 to 24% more iron, 22 to 32% more manganese, 13 to 54% more copper, and 11 to 12 more zinc in their grain than did the checks.

In summary, the high methionine and carotenoid corn hybrids differed clearly from commercial hybrid checks by delivering significantly more methionine, carotenoids, and trace minerals at comparable, but somewhat lower yield levels. However, diet modeling and financial budgeting showed that the value of the Mandaamin crops per acre for poultry production were equivalent to the conventional hybrids based on the higher methionine content in the grain reducing the need for soybean meal.

Plant Partnerships with Endophytic Bacteria and Research at Rutgers University

Early isotope based research showed that certain landraces of corn had the ability to fix N_2. After extensive breeding efforts, N_2 fixing inbred families were developed such as C4-6 and LAT-7. These varieties appear to be fertilized with N when they are not fertilized. Both of these families produce mucoid secreting brace roots and these may harbor N_2 fixing bacteria that feed the plant with N. However, the C4-6 family appears to be N efficient from emergence on, long before brace roots are formed. Furthermore, hybrid trials on five sites suggest that application of manure to C4-6 derived hybrids reduced yields but increased yields of a conventional hybrid and other Mandaamin hybrids. These facts suggest that N efficiency in C4-6 is more complex than brace root colonization.

Research by James White's microbiology group at Rutgers University (see literature list below) help explain some of the breeding program results. The Rutgers research, carried out mainly with wild or semi domesticated plants, showed that 1) endophytic bacteria can induce rhizophagy cycles caused by seed-borne endophytes; 2) these bacteria increase mineral nutrient uptake and obtain N from the atmosphere; 3) the dialogue between bacteria and plant takes place in root hairs and in plant shoots; 4) This biochemical dialogue involves ethylene and NO/nitrate production and N_2 fixation by bacteria, superoxide/hydrogen peroxide production by plants, N and increased N uptake.

Essentially a special mix of selected endophytic bacteria comes from the mother plant, lives in the seed, and multiplies in root cells in root tips and in shoots, including in trichomes (hairs). The plant cells attack the bacteria with reactive oxygen and degrade bacterial cell walls and membranes, releasing proteins and minerals that are absorbed by the plant. The surviving bacteria stimulate branching of roots and production of root hairs. The bacteria are expelled through root hairs into the soil, where they grow cell walls again. There they presumably feed on soil and may be taken up by subsequently growing roots.

Grass roots show numerous roots tip meristems. These root tip meristems are the sites of internalization of microbes and extraction of nutrients from microbes in the rhizophagy cycle. Rhizophagy increases mineral uptake by plants. The presence of endophytes in maize is associated with N uptake from the air.

The plant/microbial partnership is based on a biochemical dialogue. The intracellular bacteria living in roots secrete ethylene. Ethylene triggers plants to grow root hairs and to supply the bacteria in the roots and hairs with carbohydrates. But the plant also produces superoxide which oxidizes the bacteria. In defense, the bacteria use the plant-supplied carbohydrates to fix atmospheric N_2. The bacteria then secrete antioxidant N (nitric oxide or ammonia) which neutralizes superoxide and protects their integrity. Nitrate is consequently produced and absorbed directly into plant cells

– NO (nitric oxide) + 2O (superoxide) → NO_3 (nitrate)

– $2NH_3$ (ammonia) + 9O (superoxide) → $2NO_3$ (nitrate) + $3H_2O$ (water).

This relationship is not confined to roots. In aerial parts, bacteria were most common in non-photosynthetic cells of leaves and bracts, parenchyma, and especially trichomes (plant hairs). In fact, bacteria could be seen within nuclei of non-photosynthetic cells of many plants. Staining showed evidence for the following chemicals in association with intracellular bacteria: 1) ethylene, 2) reducing sugars, 3) superoxide, 4) hydrogen peroxide, 5) nitric oxide, and 5) nitrate. Furthermore, the cultured bacteria from tissues could fix N_2 or live in N-free media.

Experiments at Rutgers with 15N enriched atmospheres showed strong N assimilation from the air in multiple species, including fescue and reed grass. Most assimilation was in aerial parts. Seed inoculated with labelled bacteria accumulated the bacteria in foliar tissues, especially around plant cell nuclei. Sterilizing the surface of seeds before planting resulted in plants with poorly formed trichomes, no bacterial infection, and no staining for nitric oxide or nitrate.

Studies of endophytes in aerial parts extended to several grasses including reed grass (*Phragmites australis*), crab grass (*Digitaria sanguinalis*), tall fescue (*Festuca arundinacea*) and red fescue (*Festuca rubra*). Studies showed that in the grasses bacteria are cultivated within nuclei where sugars fuel nitrogenase and bacterial replication. The bacteria are released into the cytoplasm of the cell in vesicles. Bacteria, once released from nuclei, begin to secrete ethylene. Bacteria in the cytoplasm are exposed to host-produced superoxide in the cytoplasm. Bacteria respond to superoxide with secretion of antioxidant forms of nitrogen. Such nuclear symbioses were seen in the epidermis and in simple trichomes .Furthermore, grasses have serrated epidermal cells and bacteria accumulate in the wall serrations

Studies with Mandaamin inbreds at Rutgers showed that their seedling roots were strongly colonized with bacteria. These bacteria were associated with production of root hairs and were excreted from root hairs. Such seed-borne rhizophagy was not found in conventional inbreds. Furthermore, visual microscopic inspection showed differences in the kind of microbial colonization between Mandaamin Institute's inbreds. Mandaamin's leading N_2 fixing inbred, C4-6, appeared to be forming dense accumulations or plugs of some kind of material in the roots, associated with bacteria. This inbred appears in the field to have dense trichomes on its leaf sheaths, and it also has densely branched roots that seem resistant to fusarium root rot.

Paradigm Shift

Reflection on these findings indicates that maize is a capable farmer and selectionist, too. The implications lead away from a top-down approach to breeding to partnership breeding. The low N input, moderate stress, biodynamic /organic environments under which maize was selected may have also enhanced opportunities for emergent, maize-plant-driven, evolution/variation/selection. It seemed that maize is doing creative parts of the breeding work itself through emergent evolution. Maize has the ability to adapt to environments and to shape creative partnerships with a team of microbes. The role of the breeder can be redefined as being to select good, adapted, body forming partnerships but breeder capacities need to be continuously refined by fully engaging in learning from the plant/microbial team.

When plants employ rhizophagy and foliar endophytes, the mode by which plants obtain N expands beyond obtaining water soluble nitrate and ammonia to include microbial biomass-N, extractable organic N, and microbially responsive N_2 fixation in growing organs.

Practical Questions

Pertinent questions arise from these results. How N efficient are the Mandaamin hybrids? How much can farmers reduce fertilization? How well do soil tests predict N relations for N efficient corn? To begin to address these questions Mandaamin Institute carried out strip test and randomized experiments on working organic and conventional farms. Research support was given by the University of Illinois, University of Wisconsin Extension, USDA-ARS and financial support came from USDA-NIFA-OREI and SARE programs and from the Ceres Trust. This research compared Mandaamin hybrids with a commercial hybrid check. It addressed the question: "how do different farming systems affect N uptake from soil and air?" Therefore, N uptake and δ15N measurement were critical measurements. The δ 15N value assesses the ratio between the two natural isotopes 14N and 15N. The higher the value the greater the concentration of 15N. Soil organic matter, and especially soil microbial biomass and easily available N (composed mainly of dead microbes) have higher 15N content than air and hence higher δ15N values. This is because bacteria consume soil organic matter and accumulate 15N as they selectively release more14N than during nitrification and denitrification (isotopic fractionation). Our previous studies in 2009 and 2010 (Goldstein et al., 2019) showed that the grain resulting from many of our inbreds and populations had higher δ15N values than conventional inbreds and hybrids. But the grain of very high chlorophyll, putative N fixing populations had very low δ15N values.

Early assumptions were that 1) Mandaamin varieties have more active rhizophagy cycles.than conventional corn. Rhizophagy should affect a higher mineral and N uptake from soil. It should raise δ15N values by increasing N uptake from microbial biomass and easily available soil organic matter. This should be especially apparent in root composition which is close to the high 15N source. 2) In hybrids where N_2 fixation is also fostered by endophytes, δ15N in grain would be lower than for conventional inbreds because the N taken up from the soil is progressively diluted with 14N from the air. This should be especially apparent in tops and in grain. Hence, the expectation was that in the best N efficient hybrids the δ15N levels are being simultaneously increased and decreased in the plant parts by these competing plant/microbial activities.

Three System Study in 2019

Farms represented different farming systems. There were two farm sites each in three systems. The arable organic farms centered on production of crops with inputs of poultry manure. The cattle-based organic system was where cropping centered mainly on dairy or beef production and forages were a major part of production. Conventional monoculture was a dairy system where large quantities of slurry were applied to monoculture corn. Four hybrids were tested. These were the FOS8500 control which is a conventionally bred, high yielding commercial hybrid.

Three Mandaamin hybrids were C2B2-1.C46 (=C2B2 x C4-6), 17.461 (=17 x C4-6), and 17.2B24 (=17 x C2B2). The first two of these hybrids were expected, on the basis of field and microbial observations, as being putative N_2 fixers with rhizophagy. Crops were grown and harvested. Soil samples were taken after planting for organic sites and tested for total C, total N, mineralizable N, and particulate organic matter-C. Soils were sampled under the corn in September on all sites and tested for protein, protein score, SLAN, nitrate, CO2 respiration, bulk density, and aggregate stability.

Results

Samples taken at planting time showed that the two sites in the organic arable organic systems had higher levels of available phosphorus and potassium. The two sites in the cattle-based system had higher levels of total C and N, greater amounts of potentially mineralizable N, and higher amounts of particulate organic matter. We modelled crop performance parameters with an analysis of variance that included farming system, hybrid, system x hybrid, and total organic N and C/N as covariates. The percentage of the total sum of squares accounted for by the factors soil organic N plus the C/N ratio were substantial. They were 36% for grain yield, 57% for stalks/acre, 51% for roots/acre, 45% for N uptake/acre, 66% for C uptake/acre, 45% for tissue %N, 87% for δ15N in grain and 27% for δ15N in roots.

Early soil tests were also correlated with soil test results in the fall. The vast majority of the variation for the nitrogen related parameters could be explained by total carbon and nitrogen and the relationship between them (99.6% for soil protein, 99.7% for protein score; 96% for SLAN; 75% for nitrate, and even 85% for CO2 respiration). Soil C, N, and C/N attributed less to the variation found in values for aggregate stability and bulk density but there, the young fractions of particulate organic matter C and potentially mineralizable N correlated better.

Fall soil test results were correlated with crop performance. Soil protein content and scores and soil structure (aggregate stability and bulk density) correlated strongly to grain, root yields and total N uptake. Soil under the Mandaamin hybrids had 18% lower nitrate and 13% higher aggregate stability than the control.

In line with these soil quality parameters the arable organic system produced the lowest yields and the organic cattle-based system produced the highest yields. The conventional monoculture system was least efficient at transferring N to grain. The FOS8500 produced 11% more grain but less stalk and root than the hybrids crossed with 17. On average, across the systems, the Mandaamin hybrids took up 5-19% more macronutrients (N, P, K, Ca, Mg, S) and 14-20% more micronutrients (Fe, Cu, Zn, Si, Al, Ti, Sr) per acre than the conventional hybrid.

The Mandaamin hybrids had lower δ15N values for their grain but high values for their roots, relative to the conventional control. On that basis N derived from air in grain was preliminarily estimated to range on average from 26 to 34% for the Mandaamin hybrids and 12% for the FOS8500. The highest fixation occurred for the C2B2-1.C46 under the arable organic system (48%) but for the 17.461 and 17.2B24 the highest fixation was under conventional conditions (47 and 40%, respectively). The δ15N values for grain correlated negatively with grain and stalk parameters and with mineral accumulation for multiple macro and micro elements.

Preliminary estimates of total N obtained from soil biomass and easily available soil organic matter relative to FOS8500 was based on natural isotope abundance in roots/stalks. Uptake was 16 to 26% higher for the Mandaamin hybrids.

Discussion and Summary

The Mandaamin hybrids yielded 10-11% less grain but produced more stalks and roots than the conventional hybrid. Selection for inbred vigor and robust performance, and endophytic partnerships may have shifted towards investment in greater vegetative production. The stalks and roots of the Mandaamin hybrids were richer in N which means more protein and possibly better silage value.

In general, the mineral content of the Mandaamin hybrids is higher than conventional hybrids and, in many cases, goes beyond any kind of concentration affect associated with a lower yield. In 2019, the Mandaamin hybrids took up 5-19% more macronutrients and 14-20% more micronutrients than the conventional hybrids. Experience from other sites shows that the relative uptake of individual minerals varies from site to site and year to year.

Clearly, soil organic C and N, C/N ratio, and soil protein content appear to be major determining factors for crop performance in this experiment, irrespective of how the different hybrids got their N. However, the Mandaamin hybrids do obtain their N differently than the conventional hybrid. N fixation and N and mineral accumulation from soil were greater for the Mandaamin hybrids than for the conventional hybrid. There was less nitrate under the Mandaamin hybrids which might be due to less nitrification. Aggregate stability was greater for the Mandaamin hybrids as well.

Results from Rutgers and Mandaamin research suggest that endophytic partnerships can result in N_2 fixation from aerial portions plus enhanced mineral uptake. Earlier studies (Goldstein et al. 2019) and other research done in 2020 on farm sites that is not reported here confirmed that the Mandaamin hybrids have considerably higher 15N uptake from soil than conventional hybrids. This likely has to do with uptake of 15N rich, easily available organic N and microbial biomass-N through the rhizophagy cycle. Lower δ15N values for the conventional control hybrid probably have to do with such crops relying on uptake of NO_3 and NH_4 which have low δ15N values.

According to the Rutgers studies, wild plants and maize fix N from the air, making wild plant standards unreliable. Nitrogen derived from air calculations could be derived either by a) comparing Mandaamin hybrids with the FOS8500 check or b) by estimating the amount of N derived from the air in the grain by calculating the difference between the highest δ15N achieved in the root or the stalk and the δ15N found in the grain. The contrast in δ15 values should indicate the dilution effect within the plant due to N_2 fixation.

Our calculations appear to confirm that accumulation of 15N from soil microbial biomass/organic matter and enhanced 14N uptake through N_2 fixation are occurring simultaneously in roots and tops of the Mandaamin hybrids. Furthermore, the δ15N values were negatively correlated for multiple macro and microelements suggesting that fixation and rhizophagy may be coupled.

The interpretation presented here is based on natural isotope literature on soil and atmospheric N pools (Craine et al., 2015). This perspective may become more refined when more knowledge is gained on bacterial endophytes and isotope partitioning in these hybrids. It is important to continue to gain pertinent information from these crops and their N and mineral uptake on multiple farm soils and sites to aid the learning process. Furthermore, Mandaamin corn should be grown in 15N enriched atmosphere studies to confirm N_2 fixation.

The Mandaamin hybrids differ in their performance in different systems. Plants grown in the conventional system averaged the highest level of fixation but the Mandaamin hybrids had the lowest level of N accumulation from soil organic matter relative to FOS8500 when they were grown in that system. C2B2-1.C46 appeared to be the best hybrid at fixing N and obtaining N from soil organic matter but it did relatively poorly in the conventional monoculture system.

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Student Collaborative Organic Plant Breeding Education (SCOPE): Cultivating new varieties and future plant breeders

Antonia Palkovic, Laura Roser, Will Hazzard, James Weeks, Shubham Malani, Travis Parker, Danyelle Forte, Luis Salazar, Allison Krill Brown, Priti Saxena, Paul Gepts, Allen Van Deynze, Katharina Ullman, E. Charles Brummer

The Student Collaborative Organic Plant Breeding Education (SCOPE) project is a student-led collaborative of faculty, research staff, and student plant breeders working with local organic growers on improving crop varieties for organic farming systems in California, especially Northern California where UC Davis is located. The project began in 2016 in direct response to California's organic growers, who have reported a scarcity of cultivars that meet the needs of organic farming. Using traditional, field-based plant breeding methods, new varieties of tomatoes, jalapeño peppers, bell peppers, common bean, lima bean, wheat, zinnias, sweet potatoes, and more are being developed on certified organic land at The Student Farm at UC Davis. More advanced materials are tried on-farm with grower support and input. Additional trials are held at Cal Poly Pomona to breed for the hotter, drier conditions of Southern California. The breeding objectives of these projects were selected based on input from local organic farmers as well as input from our collaborators, including the Organic Seed Alliance. Since 2016, over 40 graduate students and over 80 undergraduate students have participated in our breeding programs. In addition to their direct involvement in the breeding projects, students have the opportunity to participate in seminars quarterly and conduct public outreach.

Zinnia

The goal of the zinnia breeding program is to create novel zinnia flowers adapted to organic agricultural systems. Specific goals for the zinnia program include:

- Novel color phenotypes with an emphasis on pastel and neutral tones, as well as bi-color phenotypes.
- Novel color and petal shape combinations, particularly for “cactus” type flowers.
- Improving important horticultural traits in commercial varieties, including vase life, stem length, and powdery mildew resistance


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To advance the goals of the zinnia program, we use a modified pedigree-based breeding strategy with a greater emphasis on families rather than single plant selection. The strategy was designed with diversity in mind: to create flower varieties with enough genetic diversity to prevent collapse within the population, while maintaining the phenotypic homogeneity to release a distinct and marketable flower variety.

The first step in our strategy was to evaluate available zinnia germplasm, then conduct a series of wide crosses. From there, crosses were organized into an "ideotype" in an F1 generation based on our breeding goals. Selections were made from these progenies for performance, then full-sibling and half-sibling crosses were conducted, along with some single plant selection to fix favorable traits. In the F2 and subsequent generations, individuals will be rogued out from the ideotype population until homogeneity is achieved.

Since its inception, the zinnia program has both advanced its breeding goals, and created numerous protocols for the breeding and production of zinnias. The program has conducted 248 controlled crosses between parents, and evaluated and phenotyped over 900 individual plants from 82 unique families.

The program will be entering its third field season in spring/summer 2022, and will be evaluating F2 and F3 family generations.

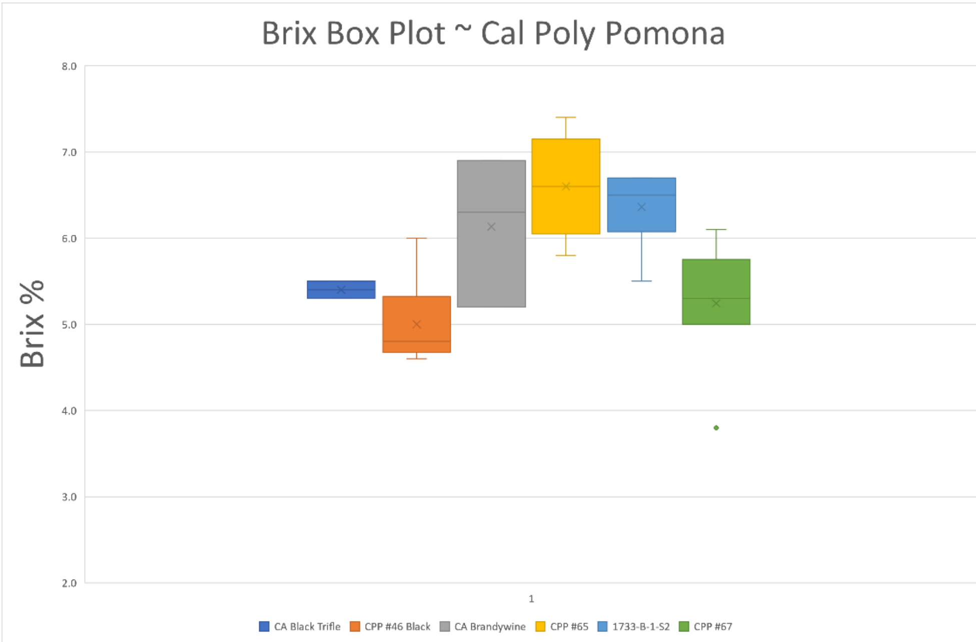
Tomato

The main objective of the SCOPE tomato breeding program is to generate improved heirloom-type, fresh market varieties for organic agricultural systems with a focus on agronomic traits, yield, fruit quality and flavor. Specifically, SCOPE seeks to:

- Generate inbred red slicer lines with improved disease resistance and yield
- Generate F1 hybrids with improved disease resistance, yield, and flavor

In order to generate inbred lines, the tomato breeding program maintains a pedigree of single-plant selections and crosses from parent varieties screened for yield, flavor, blossom end rot resistance, and sunscald resistance. Single plants are selected from their segregating families based on flavor and field performance. Using marker-assisted selection, progeny from our selections are also screened for nematode resistance (Mi23), Fusarium Race 1 and 2, Verticillium wilt, and Phytophthora Race 2 and 3. With the use of marker-assisted selection, the tomato program has been able to stack homozygous resistances in several families, with three F4 families having resistance to five of the six traits above and one F4 family having progeny with resistances across all six diseases.

In 2021, the UCD SCOPE project, Cal Poly Pomona (CPP), and collaborating organic tomato breeders pooled together 23 inbred tomato lines from our breeding programs to conduct field trials in multiple environments in order to select potential parents for F1 hybrids. The planting at CPP took place at a certified organic field at the Spadra Farm and the planting at UCD took place at the certified organic Student Farm. These 23 lines were also screened for disease resistance markers, and evaluated for yield, brix and fruit quality (firmess, percent marketable yield). They were also evaluated in a taste panel to gather preliminary information on flavor acceptability. For feasibility, the top performing six lines were selected from these 23 for a half-diallel, in which crosses are underway and the F1s will be used for field trials.



Wheat

The objective of SCOPE's wheat breeding program is the development of wheat varieties that meet the needs of California's organic growers and artisanal food producers by combining improved agronomic traits with unique flavor profiles, unique colors, and high baking quality. Our varieties are being bred for and evaluated by small growers and bakers to be used for whole wheat baked goods, such as bread.

We have made crosses between heritage varieties valued for unique flavor and modern varieties with high yield, disease resistance, and resistance to lodging. We are developing blue, yellow, and charcoal colored wheat varieties by incorporating high anthocyanin and lutein traits into populations. The resulting high antioxidant, colored varieties are intended for whole wheat baking. Additionally, we are evaluating and increasing seed of varieties which have expired patents or are no longer under plant variety protections (PVP) from across the U.S., with the intent to release the tested varieties to farmers to grow and save their own seed. We began with 78 varieties from the USDA and have selected 22 as potential "new" varieties for California organic farmers. Some varieties were released for on-farm trials in 2021.

An important part of wheat breeding is quality analysis. The percentage of protein in organic wheat is usually lower than that of conventional wheat. Additionally, whole wheat flour is different from white flour, which has the bran and the germ removed. Therefore, a simple test of the percentage of protein isn't sufficient to evaluate our breeding lines. We work with the California Wheat Commission to evaluate our lines for baking quality. Two analyses which we have found to be the most informative are the mixograph test and the sedimentation test. Together, they provide a good estimate of protein type and quantity. We also conduct 100% whole wheat bake tests and participatory taste tests which are the most informative, but also the most time intensive. Using a combination of analysis techniques, we are able to evaluate our breeding lines and many varieties.

Pepper

The pepper team has two breeding projects:

- Breed a jalapeño pepper with high yield, good fruit quality and an enlarged cavity preferred for making jalapeño popper dishes
- Breed a sunscald tolerant bell pepper to improve marketable yield, while maintaining comparable fruit color and flavor to varieties that are used on California organic farms.

Three pepper lines, one bell and 2 jalapeños, are ready to be released this year (2022) or next year (2023). These lines were produced through single plant selections made from crosses between inbred bell or jalapeno pepper varieties, or self-pollinated F1 hybrid varieties. To assess yield, samples of 6 plants from plots or strips of peppers were harvested, sorted, and weighed. Non-marketable fruits affected by blossom end rot, sunscald, and other defects were weighed separately. Jalapeño peppers were measured for length, width, and pericarp thickness.

One advanced yellow bell pepper line (F11), CK, was tested on three farms in Yolo County in 2020 and 2021. Across both years, this line had a 36% higher marketable yield at the end of the season than the two check varieties, 'Golden California Wonder' and 'Red Knight', probably due to the lateness of flowering and fruiting. In 2021, the peppers were trialed under shade at one farm. CK lost zero fruits to sunscald from both of the harvested samples (total 12 plants) from that farm. The fruits from CK are also sweeter and juicier than the green fruits of other varieties it was compared to. It may be a good late season variety, and could be marketed as a more flavorful green pepper. The bell pepper typically has 4-5 deep lobes and is shorter than the average bell pepper

Two jalapeño lines, CI and CF, were tested in 2020 and 2021 on farms in Yolo County. Both are wider than the comparison variety, 'Early Jalapeño', and had a comparable or higher yield. CF (F9) is low to moderately spicy, blocky, and has a very thick fruit wall. CI (F9) is longer than the average jalapeño, has a thin fruit wall, and is moderately-to-very spicy. Both varieties were evaluated through participatory taste tests in 2019, 2020 and 2021.

Common bean

The common bean SCOPE project has worked to combine the culinary properties of heirloom beans with the productivity and disease resistance of commercial types. To achieve this, cross-pollinations were made between promising heirloom varieties and UC Davis varieties with high yield and resistance to bean common mosaic virus (BCMV). Progeny were screened for resistance to BCMV using virus inoculations and genetic tests to identify types which inherited virus resistance. Selections for yield occurred in 2017, and promising types were grown in collaboration with OSA and organic farmers in 2018-2019 to select types with maximum yield. The best of these were used in taste tests in 2019, which identified several types with the cooking quality of the heirloom varieties. In 2020, five new cultivars were released and registered, with yields 19-60% higher than the original parent varieties and similar flavor and appearance.

These new varieties are available through farmer Mike Reeske of Rio del Rey Organic Farm, who was a farmer-collaborator and also helped fund the project. He can be reached at: mreeske@aol.com

Left: Five new varieties of common bean publicly released and registered by the SCOPE project (clockwise from top left): UC Southwest Red, UC Southwest Gold, UC Sunrise, UC Rio Zape, UC Tiger's Eye (center). **Right:** Taste tests of new common bean varieties grown on organic farms.

Assessing the resilience of the organic seed system: A network perspective

Liza Wood, University of California - Davis

Abstract

The organic seed system involves a complex network of organic seed stakeholders, yet we have a limited understanding of the system's 'resilience.' This research asks 1) How do seed stakeholders define a resilient seed system? 2) How does the organic seed network reflect these definitions? To answer these questions stakeholders were surveyed for the 2021 State of Organic Seed report. In their definitions of a resilient seed system stakeholders emphasize regional cooperation for managing genetic diversity, access to information, and efficient supply chains. These definitions match scholarly theory: resilient networks should balance cooperation for maintaining diversity across multiple hubs, with centralized coordination for efficient resource flows. Preliminary analysis of organic seed network mapping suggests that cooperation is strong, especially for information sharing. However, centralized coordination is low, especially for supply chains, signaling potential inefficiencies. This presentation will open discussion about strategies for improving resilience of the organic seed network.

Introduction

Seeds, and the genetic material they contain, are a foundational component of the agricultural systems they support. Seeds are the product of seed systems – the plant breeders, seed producers, companies, farmers, organizations, and regulators who collectively breed, distribute, grow, and regulate the seeds of our food crops. Understanding how the various stakeholders in the organic seed system are organized can help inform management of this system towards certain goals. Today, many promote the goal of a 'resilient' agricultural system to adapt to a changing climate and stand up to social and political change (Petersen-Rockney et al. 2021). But defining and measuring resilience can be complicated, especially in systems with social and ecological dimensions. Resilience scholars emphasize the importance of diversity for different types of stakeholders and sources of knowledge, and redundancy of expertise and resources to provide a backup in case of loss (Folke 2006). But how to measure these features in social systems is an ongoing conversation (Cabell and Oelofse 2012, Tittonell 2020).

One approach for analyzing social and ecological system resilience is through networks: maps of the relationships between different stakeholders in a system (Janssen et al. 2006, Labeyrie et al. 2021). The kinds of relationships that can be mapped are many-fold. Networks can be used to understand the sharing of information, which is an important determinant of behavioral change and relationship building (Lubell et al. 2014). They are also useful for understanding business relationships along complex supply chains (Lee et al. 2014). And the exchange of genetic material is also a burgeoning field for network studies (Garrett et al. 2018). Understanding how genetic resources are shared across the seed system can help identify bottlenecks to diversity and access to genetic material, which is a key element for developing adaptive agricultural systems. Altogether, network relationships can give insight into the diversity and redundancy of stakeholders and their connections, as well as the cooperation (horizontal, polycentric networking) and coordination (centralized networking) that take place (Barnes et al. 2017). These concepts can be used to quantify and assess resilience social-ecological networks.

Objectives

Building regional seed networks that support a resilient national system is key to supporting organic seed. Seed networks involve a variety of stakeholders relating in different ways, from sharing seed to sharing knowledge, from the local to the national level. This research sets out to identify the features of a resilient seed system and then map and assess the current seed system network structure. As such, this research asks the following questions:

1) How do organic seed stakeholders define a resilient seed system?
2) What is the structure of the organic seed system network and how does it reflect stakeholders' definitions of a resilient system?

Methods

Surveys and data collection: Organic Seed Alliance conducted a formal survey of organic seed growers and organic seed suppliers in 2021. 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, their own personal definition of resilience, and their perceptions on climate change and intellectual property rights. For networks, the survey asked about the people or organizations that respondents source germplasm for breeding and exchanging seed (seed exchange connections), where they seek information on seed production and who they collaborate with on research (information connections), and who they work with along the supply chain, including seed contracts, equipment rental, and sales (supply chain connections). Surveys were hosted on the Qualtrics survey platform and distributed over email. Each potential respondent was sent an initial email invitation with three reminders, spaced out every two to three weeks.

Sample representativeness: Out of those we surveyed (416 seed producers identified by the National Organic Program database and 90 seed companies identified through an expertly generated list of seed company contacts) we heard from 88 seed producers and 39 companies for a combined response rate of 25% (127/506). Regionally, the response rate was 22% from the North Central region (20 of 92), 23% from the Western region (67 of 293), 29% from the Southern region (10 of 35), 32% from the Northeastern region (17 of 54), 20% from Canada (3 of 15), and 20% from those with other locations (3 of 14).

Analysis: The focus of this research was on questions related to respondents' seed system resilience definitions and their networks. Resilient seed system definitions from an open-ended question were read and manually coded for major themes using NVivo qualitative coding software. Network responses were manually cleaned and used to create a master database of seed stakeholders, which allowed for the mapping and analysis of the organic seed network. All data cleaning, analysis, and visualization was completed in R statistical software.

Results

What makes a resilient seed network? The “resilient seed system” definitions provided by seed producers and companies 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 (Figure 1). 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 maintain functionality (i.e., keep producing seed), build in redundancy, and 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.

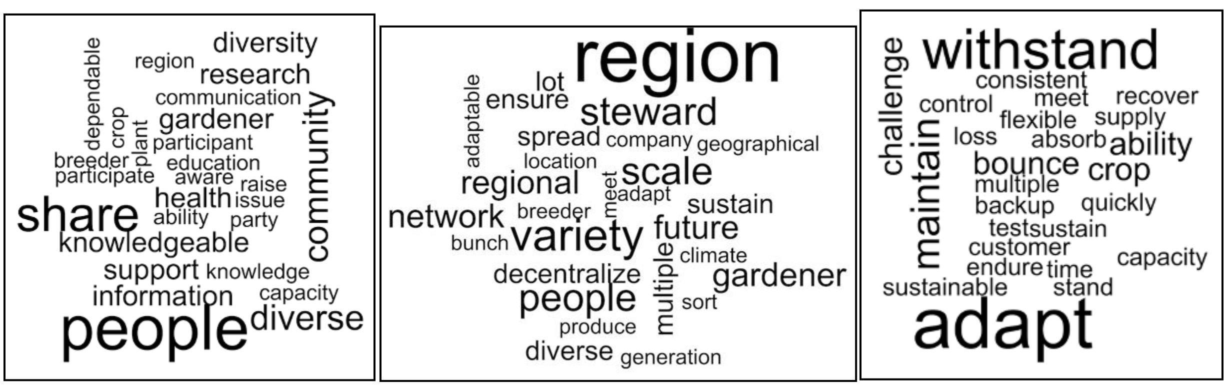


Figure 1. Resilience definition word clouds by theme. Left: The role of community, center: the scale and scope of the network, and right: system tendencies in the face of stress

How is the seed system network structured? When asked about their organic seed connections – those who they exchange seed with, get information from, and work with along the supply chain – survey respondents named a whole range of stakeholders, including other seed producers, processors and retailers, organizations, university researchers, and government agencies. These connections help us understand key steps in the life cycle 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 identified in the network make over 800 connections, signaling the interdependence of those in the seed system (Figure 2). 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 2. Organic seed system network. Each circle represents a stakeholder. Circles are color-coded based on their role in the seed system and sized based on the number of connections they make. Green = seed producer, red = seed retailer, yellow = non-governmental organization/non-profit, blue = government or university.

Network diversity can be thought of geographically (connecting within or between regions) and professionally (connecting with others in similar or diverse roles). Seed stakeholders from the smaller regions, the South, Northeast, and North Central, often reach out to stakeholders outside their region (about 65% of the time) especially to others in 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. In both the Southern and Western regions, seed producers connect with stakeholders from a more diverse set of expertise and professions. 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% of their networks, while diverse connections account for only 43% of connections in the Northeast and 55% in North Central.

How is germplasm sourced? 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. While most 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 across all the regions, indicating the important role of this centralized, publicly funded source of germplasm.

How is information and research shared? Of the different types of connections considered in this research, the seed system's information network is 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 collaborate with on projects – are to specialized groups (70%), such as non-profit organizations, universities, farming cooperatives, and government agencies. 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% of information connections are to other producers, which survey responses suggest 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 companies support one another through mutual learning.

How are supply chain relationships organized? Supply chain connections are the least common kind of connection that seed stakeholders make in their networks, involve the lowest crossover between regions, and the lowest diversity of professions. 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, which may be a consequence of the limited supply chain network in this region.

Conclusions

Seed stakeholders' definitions of a resilient seed system emphasize regional cooperation for managing genetic diversity, access to information, and efficient supply chains. These definitions match scholarly theory: resilient networks should balance cooperation for maintaining diversity across multiple hubs, with centralized coordination for efficient resource flows. Network analysis of the seed system is used alongside these definitions to provide insight into the seed network's resilience. The organic seed system network structure largely reflects the definitions of a resilient seed system set out by stakeholders. The organic seed system connects a wide diversity of stakeholders across and within regions. Stakeholders access information, genetic material, and supply chain connections both horizontally, from their peers and within their region, and vertically, from stakeholders with different expertise from across the country. 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, there are also resources distributed across regions. Cooperation among stakeholders is generally strong, especially for information sharing, but centralized coordination is low, especially for supply chains, signaling potential inefficiencies. This work provides a preliminary look at the connections and composition of the organic seed network to guide management towards a resilient seed system.

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Towards an Equitable Seed System: Resource Access and Barriers Across the Northeast Seed System

Megnot Mulugeta, University of Vermont

Daniel Tobin, Ph.D., University of Vermont

Background

Despite the prominence of the highly consolidated conventional seed system in the United States, farmers, gardeners, and seed keepers continue to use alternative seed systems, comprised of both formal (i.e., organic seed companies, university plant breeders, etc.) and informal (i.e., farmer- and community-managed) sectors, to access organic, culturally meaningful, and/or open-pollinated planting material. People engaged in alternative seed systems pursue broad-ranging goals that are beneficial to their communities and ecosystems including diversifying food production, reconnecting with agrarian heritages, and facilitating access to nutritious, culturally appropriate planting material and food produced from it.

However, individuals and communities engaged in alternative systems have raised concerns that their wide-ranging benefits and opportunities are not equally accessible to all, prompting questions about the equitable distribution of resources and differential barriers that exist for members of marginalized populations. Given the role of agriculture in creating and perpetuating marginalization in the United States, investigating the distribution of resources and differential barriers within alternative seed systems is important to assess.

Research Objectives

This study explores the diverse experiences of individuals participating in alternative seed systems. In particular, we focus on how identity and position within alternative seed systems in Northeastern U.S. influence access to resources, barriers, and feelings of empowerment. We present data from a survey conducted in the months following the 2021 Northeast Organic Seed Conference (NOSC), guided by the following objectives: (1) determine how access to resources is distributed across diverse seed workers; (2) assess how challenges to seed work are perceived across diverse seed workers; and (3) ascertain the degree to which diverse seed workers experience power in their seed work and whether differences exist across identity and position within the Northeast organic seed system (NOSS).

Methods

The survey used to inform this research was designed based on themes that emerged from note-taking and group work sessions during the virtual 2021 NOSC (January 16-23, 2021) and was deployed in June-July of 2021. The target population for the survey was the conference attendees and other individuals in their networks engaged in Northeast organic seed systems. In late June 2021, a survey link was sent to the 378 NOSC attendees with an encouragement to share the survey with their peers in the Northeast who did not attend the conference. Responses were collected until late July, resulting in 118 total responses (conference attendees=106, nonattendees=12). Using the Statistical Package for Social Sciences (SPSS) version 28, a series of descriptive and bivariate statistical tests were performed to address the study objectives. Table 1 provides a summary of the survey respondents' characteristics.

Table 1. Sample Characteristics of Independent Variables

Characteristics	n	Percentage/mean (SD)
Role in the NOSS[a]	118	
Community Based/non-profit Seed Work	53	44.9%
Home Based Seed Work	43	36.4%
Commercial Farmers	28	23.7%
Plant breeders/Researchers/Extension agents	26	22.0%
Commercial Seed Producers	23	19.5%
Seed Companies	16	13.6%
Race	106	
White	79	74.5%
Non-white	27	25.5%
Gender	97	
Women	69	71.1%
Men	21	21.6%
Non-binary	5	5.2%
Prefer to self-describe	2	2.1%
2020 Household Income	92	
Less than $25,000	15	16.3%
$25,000-$49,999	37	40.2%
$50,000-$74,999	14	15.2%
$75,000-$99,999	12	13.0%
$100,000 or more	14	15.2%
Age	97	45.4 (14.3)[b]
Years in seed work	90	7.6 (6.7)[b]

[a] Respondents were able to choose more than one response, so percentages will not add to 100%.

[b] Means and standard deviations are presented with outliers removed.

Findings

Descriptive Statistics of Resources, Challenges, and Empowerment

We first assessed access to resources by asking 13 agreement statements pertaining to the degree to which respondents felt that they had access to different resources As Table 2 indicates, respondents felt they had the most access to information about growing seed crops (M=3.20) and the least access to funding to support non-commercial seed work (M=1.90).

Table 2. Mean Responses to "How accessible are these resources to meet your needs for your seed work?"

Resource	Mean	SD
Funding to support non-commercial seed work (n=78)	1.90	0.66
Legal counsel and advice for your seed work (n=75)	1.92	0.65
Funding to support commercial seed work (n=78)	1.99	0.67
Funding for research and experimentation (n=85)	2.18	0.73
Information about distributing and selling seeds (n=94)	2.50	0.56
Tools and equipment for harvesting and processing seeds (n=101)	2.50	0.76
Information about how climate change affects your seed work (n=100)	2.54	0.67
Land for growing desired amounts of seeds (n=101)	2.70	0.94
Desired seed varieties (n=95)	2.77	0.59
Tools and equipment for growing seeds (n=101)	2.91	0.71
Inputs to grow seeds (fertilizers, soil, etc.) (n=97)	2.95	0.65
Information about harvesting and processing seeds (n=104)	3.00	0.61
Information about growing seed crops (n=104)	3.20	0.64

Note: Item responses measured from 1=Very Inaccessible to 4=Very Accessible.

We also assessed challenges through 10 agreement statements about the degree to which respondents felt that different issues were challenging (objective 2).Table 3 shows that respondents felt that reliable technology was the least challenging issue (M=1.51), and financial capital was the most challenging (M=2.86).

Table 3. Mean Responses to "How challenging are the following for accessing resources to meet your needs?"

Obstacle	Mean	SD
Reliable technology (phones, computers, etc.) (n=96)	1.51	0.78
Reliable transportation (n=96)	1.54	0.87
Reliable internet (n=97)	1.57	0.83
Language barriers (n=97)	1.60	0.80
Physical ability to lift, push, or move heavy materials (n=94)	1.62	0.82
Technical knowledge related to your seed work (n=99)	2.43	0.89
Legal regulations around seeds (n=91)	2.53	0.90
Available time (n=98)	2.83	0.94
Financial capital (n=98)	2.86	1.02

Note: Item responses measured from 1=Not at all Challenging to 4=Very Challenging.

A third set of questions assessed empowerment by asking 6 agreement statements about the degree to which respondents agreed with "I have the power to…" statements. As displayed in Table 4, respondents felt most empowered to make decisions about the seeds they grow (M=3.35) and the least empowered to influence policy (M=2.39).

Table 4. Mean Responses to "Please rate how much you agree with the following statements. 'I have the power to…'"

Resource	Mean	SD
Influence policy regarding seed production (n=103)	2.39	0.74
Engage in profitable business opportunities related to seeds (n=92)	2.54	0.83
Have the seeds I grow recognized as belonging to myself or my community (n=92)	2.82	0.68
Participate in beneficial partnerships to advance my seed related goals (n=92)	3.08	0.59
Improve the seed system(s) I belong to (n=97)	3.09	0.60
Make decisions about the seeds that I grow in ways that aligns with my values (n=100)	3.35	0.67

Note: Item responses measured from 1=Strongly Disagree to 4=Strongly Agree.

Bivariate Analyses Between Characteristics and Resources, Challenges, and Empowerment

Using the above three sets of questions, we then created three composite scores representing overall access to resources (ranging from 1 (very low access) – 4 (high access)), challenges (ranging from 1 (minimal challenges) – 9 (many challenges), and power (ranging from 1 (low perceptions of power) - 6 (high perceptions of power)). Using these composite scores, we conducted Pearson correlation tests, independent samples t-tests, and ANOVA tests according to various independent variables, including position in the system (e.g. home-based seed worker, seed company representative, etc.), race, gender, location, income, age, and years in seed work. Table 5 first presents statistically significant results.

Table 5. Statistically Significant Associations between Dependent and Independent Variables

Variable	Resources (α = 0.815)		Challenges (α = 0.599)		Power (α =0.744)	
	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.
Age	-0.30	0.01	-	-	-	-
Income	-	-	-	-	0.21	0.04
Years in Seed Work	0.24	0.04	-	-	-	-
	T-value	Sig.	T-value	Sig.	T- value	Sig.
Plant breeders*	-1.76	0.04	-	-	-	-
Community seed workers	-	-	-2.23	0.01	-1.78	0.04
Seed companies	-	-	2.30	0.01	-	-
Home seed workers	-	-	-	-	2.03	0.02
Seed producers	-	-	-	-	-1.95	0.03

*Includes researchers and extension agents

Regarding resource access, age has a negative association with resource access (-0.302, p=0.01), meaning that younger respondents tend to have less resource access. Along this vein, years of seed work is positively associated with resource access (0.24, p=0.04), indicating that respondents with more seed experience tend to have more access to resources. It was also found that plant breeders (M=2.62) tend to have greater access to resources (t_{65}=-1.76, p=0.04)[1] than those who aren't (M=2.43). Regarding challenges, those who are involved in seed companies (M=1.80) experience fewer challenges (t_{83}=2.3, p=0.01) than those who are not (M=2.09). Alternatively, those who are involved in community based/non-profit seed work (M=2.16) experience more challenges (t_{83}=-2.23, p=0.01) than those who aren't (M=1.96).

Regarding power, seed producers (M=3.03) experience more empowerment (t_{82}=-1.95, p=0.03) than non-seed producers (M=2.8). Similarly, community based/non-profit based seed workers (M=2.95) feel a greater sense of power than those who aren't (M=2.78) (t_{82}=-1.8, p=0.04). Alternatively, home seed workers (M=2.72) perceive that they have less power than non-home seed workers (M=2.93) (t_{82}=2.0, p=0.02). There was also a positive correlation (0.21, p=0.04) between income and power, indicating respondents with higher income experience greater feelings of empowerment.

Limitations

While these findings provide useful insight into issues of inclusivity and diversity within the Northeast organic seed system, care still needs to be taken in interpreting them, given the small sample size and limited representation across several categories. In particular, race and ethnicity deserve more attention. While race was not statistically significant in these findings, likely due to our small sample size of non-white participants, observations at the NOSC lead us to believe that this is an important factor for resource access that must be explored in future research. Nonetheless, our findings provide an important preliminary foundation for future research.

Implications for improving equity and justice in NOSS

Our data indicate that respondents' positions in the seed system is more often associated with resource access, challenges, and empowerment than demographic factors. These findings also support sentiments from the conference that individuals and groups involved in the formal seed sector (e.g., seed companies, plant breeders, etc.) have more resources and experience fewer challenges than those in the informal seed sector (e.g., individual seed savers). While resource access and challenges can impact feelings of agency and autonomy in seed work, our findings indicate that community-based seed workers, who experience high degrees of challenge, also feel empowered in the NOSS. In order to provide specific support to those in the informal sector, future studies should focus further on how resource access and challenges impact feelings of empowerment across seed sectors.

Demographic factors, however, still affect seed workers' ability to do their work, and should likewise receive attention when considering equity and justice-oriented changes. For example, given that higher income predicts greater empowerment among respondents, income disparities and financial obstacles could be better addressed by resource redistribution. Likewise, greater focus on barriers of entry and focused engagement with young and/or beginner seed workers could be beneficial for diversifying the NOSS and supporting marginalized groups.

Overall, our findings indicate that types of seed activity – formal or informal – influence opportunities and challenges. This reflects common conditions in the Global South, where formal seed systems remain a policy focus at the exclusion of informal seed systems. At the same time, our findings are partial and preliminary. Other complex dynamics also affect resource access and feelings of empowerment, including social position and other institutions such as land access and tenure and legal rights and restrictions. In addition to position in the seed system, these other considerations must also receive attention for a more comprehensive assessment of (in)justice and (in)equity in the seed system.

Breeding Vegetable Maize for Organic Production: Quality Selection Methodology

Lexie Wilson, University of Wisconsin – Madison

Sweet maize dominates the fresh-eating maize market in the United States. However, many other fresh-eating maize types exist with various flavors, textures, and culinary properties. Due to high sugars and low seed weight, modern sweet maize varieties often have poor germination, early vigor, weed competitiveness, and ultimately yield, when grown organically without seed treatments. There is a need for varieties bred specifically for organic or low-input farming systems and an opportunity to breed novel 'vegetable maize', which contributes to genetic and culinary diversity within the U.S. landscape.

The vegetable maize project began in response to chefs who communicated a need for locally adapted fresh-eating maize with "corny" flavor and robust texture when cooked. With these goals in mind, sweet and grain maize were crossed to form experimental 'vegetable maize' populations. The fresh-eating harvest windows of these populations were very short. Ears rapidly declined in quality, becoming too tough for fresh consumption over a period of a week or less. This research will determine if the fresh harvest window of four vegetable maize populations can be widened via recurrent selection over four cycles (2020 – 2023). Quality attributes are measured with two tools that we hypothesize when selected upon will slow sugar to starch conversion and therefore extend the fresh harvest window. After one cycle of selection, the population mean of the measured traits was directionally changed in three of the four populations. Taste tests of the four cycles will determine if the harvest window is widened and if changes are desirable.

Development of Tomato Varieties Adapted for Organic Systems in the Upper Midwest, with Improved Flavor and Disease Resistance

Ámbar Carvallo, University of Wisconsin – Madison

Most of the tomato varieties currently used in organic farming were bred for conventional farming, often characterized by high-input use. These varieties do not perform as well in low-input organic systems, generating the need to breed varieties that are adapted organic management systems. This project focused on improving flavor, disease resistance, and yield, all identified as key traits for organic tomato farmers in the Upper Midwest. Four founding parents were identified as promising germplasm from organic variety trials. Following a diallel crossing scheme, we obtained F1's from the 6 possible crosses, and these were advanced to the F5 and F6 generations. The breeding lines were evaluated in open field and high tunnel organic farming systems in the university research station. Flavor was evaluated through public tastings. In parallel, the advanced lines were trialed by farmers and tested by chefs and consumers to analyze their marketable and culinary potential. We found that yield (kg/plant) was significantly higher in the high tunnel than the open field management system for all varieties. We found 4 breeding lines with outstanding flavor and acceptable overall yields. The heritability of the yield was high (0.82) and the genetic variance was also high, which shows opportunity to increase the yield on the best tasting varieties. A significant positive correlation was found between overall flavor and °Brix (0.78), and citric acid (CA) (0.71), indicating that both measurements can be good predictors of overall flavor likeliness. The correlated response of °Brix and CA when selecting for yield was -8% and -9% respectively, indicating that improving yields and flavor at the same time can be challenging on future selections. The current breeding lines show promise, further selection and on-farm trials are needed to evaluate their potential as releasable varieties.

Indigo Tomato Trial on The Evergreen State College Organic Farm

Adam M. Smith and Martha Rosemeyer, The Evergreen State College

Jim Myers, Oregon State University

During the 2021 growing season, a randomized complete block design was conducted to evaluate four experimental varieties of organic tomato seeds (Solanum lycopersicum) bred from Indigo x ‘Ananas Noire’ crosses. The goal was to combine the tasty, multihued fruit of Ananas Noire with the Indigo (high anthocyanin) trait to create an even more colorful, healthy, and tasty slicer type tomato. ‘Lucid Gem’ and ‘Ananas Noire’ were included in the trial as check varieties. Three replications included eight plants of each variety per block (n=144). Data were collected on Early Blight of Tomato, catfacing, and blossom end rot as well as plant vigor, yield, taste, and marketability of the individual fruit. The experimental Variety 2 (P321-13-3B-1-1-1) performed the best. This variety had the lowest catfacing, the lowest number of fruits with blossom end rot, the highest average number of pre-harvest fruit per plant, and the highest average number of marketable fruits per plant. In tasting trials, Variety 2 did not differ significantly from most of the other varieties on ratings of sweetness, flavor, or overall likableness. Varieties 2 and 4 (P321-7-1-1-1) had significantly higher ratings on appearance, but only compared to ‘Ananas Noire.’ Overall, ‘Ananas Noire’ was the poorest performing variety in the trial. Although it was rated as one of the sweetest and most flavorful varieties, it also exhibited significantly more blossom end rot and had the lowest average number of marketable fruits despite having the heaviest average fruit weight per plant.

Organic Potato Seed Certification to Change the World

Jeff Bragg, SuperFood Consulting

Jeff and Sandy Bragg have been working in professional potato production for over 41 years, from growing to product development. Prior to this experience, Jeff was raised to learn regenerative organic production on his parent's and grandparent's farm in the Magic Valley of Idaho. In 2013, Jeff left Green Giant Fresh as the VP of product development of potatoes and alliums, returning to his organic "roots". However, many of the varieties currently produced organically are prone to viral skin diseases carried internally, as well as on the soil adhering to the skin. This adhering soil has transmitted diseases worldwide, and a wide selection of pesticides are applied to "better" the appearance and benefit chemical companies.

Most organic producers, if not all, buy seed that has not been grown strictly from organic beginnings. Potatoes start in tissue culture, then greenhouse grown before planting in the fields. After several progenies from tissue culture, organic producers buy the certified seed to go into organic production. Never before has a potato line of a variety been started from organic greenhouse productions. SuperFood Consulting and Sandoval's Spuds created the first global planting of an unnamed variety shown to be higher quality to the organic potato producer, and better for the consumer.

Jeff and Sandy want to show why consumers should plant only seed raised strictly from organic seed potato stock. Our program is called TSM™ or Total System Management, and the end result is Soil To Belly, to help consumers. Bigger is not better in the world of potatoes.

Techniques for Regenerating Old Seeds

Frank Kutka, College of Menominee Nation

Food sovereignty is both the right of peoples to healthy food produced sustainably, and to define their own food production systems. As the food sovereignty movement continues to evolve, more Indigenous people are searching for the seeds Native ancestors used to grow traditional crops. Sometimes gardeners have viable seeds of traditional varieties in abundance, and sometimes the only seeds still in existence have not been grown out for a long time and are now very old. Others have been collected decades ago and stored in museums for display. Age eventually leads to the death of seeds, and some of the old seeds will never germinate. However, sometimes old seeds are still alive, but very weak, too weak to germinate on their own. Here we review the literature about the various ways in which gardeners and scientists have helped or may help to grow healthy plants from old, weak seeds that are still alive. Some of the methods are not traditional, each person or group involved will have to make choices among the methods based on the likelihood of success, cultural norms, and other considerations. If successful, regenerated plants can become the basis for new stocks of healthy, vigorous seeds with which relationships can be rebuilt to help meet current and future food sovereignty goals.

Weighing the Risks and Benefits of Flowering Early for the Woody Perennial *Prunus pumila (*Rosaceae)

Danielle Lake Diver and Dr. Jessica Savage, University of Minnesota - Duluth

As global weather patterns become increasingly unpredictable, the need to study the impact of this phenomenon on food crops is increasingly urgent. Based on climate change predictions for the rest of this century, much research has been conducted to reveal plants' response to stress from heat and drought. However, fewer studies have focused on the response of perennial plants to freezing, another possible result of climate change as plant phenology advances. Yet, there may be advantages to flowering early that outstrip the potential risks, especially if pollinators also adjust their phenology to warming conditions. Temperature during anthesis (when open flowers are present on a plant) has a significant impact on fertility, floral metabolism, and the production and quality of floral rewards that attract pollinators.

We examined the effects of floral freezing on pollinator attraction and reproductive success for 180 potted Prunus pumila plants. We exposed them to a simulated light freeze, hard freeze, or a near-freezing control temperature at four different floral phenophases (first white, balloon, anthesis, and post-anthesis). Visual and cellular damage were assessed in floral tissue. A subset of flowers on some plants was hand pollinated or selfed to evaluate the effects of pollen limitation. Plants were then placed in the field and observed over the course of flowering for pollinator visitation and monitored for signs of successful fertilization and reproduction. Our findings will contribute to the current knowledge of Prunus, a global genus with both economic and ecologic value that could be greatly impacted by climate change.

Community Seed Network: An Online Platform for Seed Saving, Sharing, and Networking

Jeanine Scheffert, Seed Savers Exchange

The Community Seed Network (CSN) is an online platform that connects and supports community seed initiatives by providing resources, information, and a platform for networking. The CSN's mission is to support community-led seed stewardship by offering a platform to connect people to projects, projects to each other, and everyone to seed. Through great conversations and sharing of resources, we work to make this work visible locally, regionally, and internationally, empowering community seed leaders as trailblazers and movement builders.

The idea of the Community Seed Network (CSN) started with a conversation among 25 seed librarians and seed organizers at the 2015 Seed Library Forum in Tucson, AZ who recognized the need for an online platform providing information and educational resources for seed saving and seed sharing efforts.

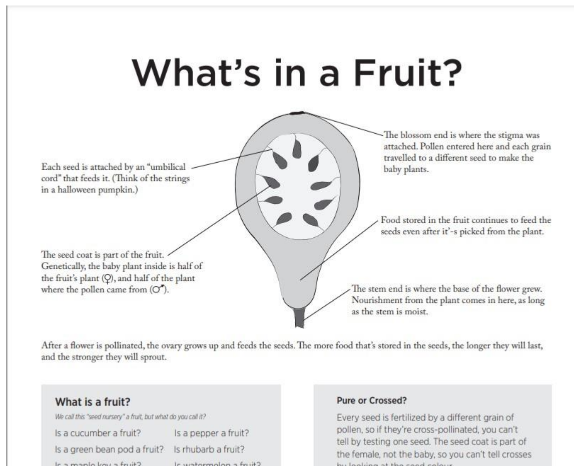
Under the leadership of Seed Savers Exchange and SeedChange, the initiative broadened to include seed libraries, community seed projects, seed swaps, and all "seedy" individuals and community groups. Today, the CSN's mission is to support community-led seed stewardship by offering a platform to connect people to projects, projects to each other, and everyone to seed.

Highlights of this online network include free, downloadable resources and a community-seed map.

Seed Savers EXCHANGE

SEED SAVING GUIDE

Crops	Species	Family	Life Cycle	Primary Pollination Method	Recommended Isolation Distance for Seed Saving	Population Size (Number of plants)		
						Viable Seeds	Variety Maintenance	Genetic Preservation
adzuki bean	*Vigna angularis*	Fabaceae	annual	self	10-20 feet (3-6 m)	1	10-25	50+
amaranth	*Amaranthus spp.*	Amaranthaceae	annual	wind	650-1,300 feet	1	5-25	50+
Armenian cucumber	*Cucumis melo*	Cucurbitaceae	annual	insect	800 feet-1/2 mile (244-805 m)	1	5-10	25+
artichoke	*Cynara cardunculus*	Asteraceae	perennial	insect	800 feet-1/2 mile (244-805 m)	5	20-50	80+
arugula (rocket)	*Eruca sativa*	Brassicaceae	annual	insect	800 feet-1/2 mile (244-805 m)	5	20-50	80+
asparagus	*Asparagus officinalis*	Asparagaceae	perennial	wind	800 feet-1/2 mile (244-805 m)	2 (1 male, 1 female)	20-50	80+
barley	*Hordeum vulgare*	Poaceae	annual	self	10-20 feet (3-6 m)	1	5-10	20+
bean (common bean)	*Phaseolus vulgaris*	Fabaceae	annual	self or insect	10-20 feet (3-6 m)	1	5-10	20+
beet	*Beta vulgaris*	Amaranthaceae	biennial	wind	800 feet-1 mile (244 m-1.6 km)	5	20-50	80+
Belgian endive	*Cichorium intybus*	Asteraceae	biennial	insect	800 feet-1/2 mile (244-805 m)	5	20-50	80+
broccoli	*Brassica oleracea*	Brassicaceae	biennial	insect	800 feet-1/2 mile (244-805 m)	5	20-50	80+
broccoli raab	*Brassica rapa*	Brassicaceae	annual/biennial	insect	800 feet-1/2 mile (244-805 m)	5	20-50	80+
broomcorn	*Sorghum bicolor*	Poaceae	perennial	self or wind	100-200 feet (30-61 m)	1	10-25	50+
Brussels sprouts	*Brassica oleracea*	Brassicaceae	biennial	insect	800 feet-1/2 mile (244-805 m)	5	20-50	80+
buckwheat	*Fagopyrum esculentum*	Polygonaceae	annual	insect	800 feet-1/2 mile (244-805 m)	5	20-50	80+
cabbage	*Brassica oleracea*	Brassicaceae	biennial	insect	800 feet-1/2 mile (244-805 m)	5	20-50	80+
cardoon	*Cynara cardunculus*	Asteraceae	perennial	insect	800 feet-1/2 mile (244-805 m)	5	20-50	80+



What's in a Fruit?

After a flower is pollinated, the ovary grows up and feeds the seeds. The more food that's stored in the seeds, the longer they will last, and the stronger they will sprout.

What is a fruit?

We call this "seed nursery" a fruit, but what do you call it?

Is a cucumber a fruit? Is a pepper a fruit?

Is a green bean pod a fruit? Is rhubarb a fruit?

Pure or Crossed?

Every seed is fertilized by a different grain of pollen, so if they're cross-pollinated, you can't tell by testing one seed. The seed coat is part of the female, not the baby, so you can't tell crosses

Resources on the Community Seed Network site are free for all non-commercial use and include resources for those learning to save seed, and those looking to begin and sustain community seed initiatives.

How to organize

Community Seed Gardens

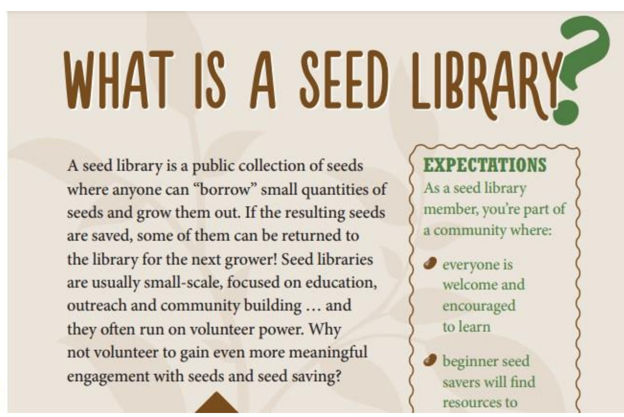
Why Seed Gardens?

Aseedgardencansupplyseedsforlocal gardeners,seedswaps,andlocalseed banks.(Ifyoudon'thavealocalseed bankorregularseedswap,checkoutthe SeedMattershow-toguides.)Adedicated seedgardenallowsyoutogrowmore seedandtosaveseedfromcropsthatare difficulttogrowinabackyardgarden. Forexample,onegardenermightnot havespacetogrow30carrotplantsto seed,butadedicatedseedgardencan handlelargerplantpopulations.Shared gardenscomewiththejoysandthe challengesofcollaborativework;inthis

Seed saving can occur in any garden, but a community space dedicated to seed creates amazing opportunities beyond what any single seed saver can accomplish.

A visible and vibrant community space:

- Educates people about the life cycle of plants
- Demonstrates the process of seed saving
- Informs and inspires residents about the value of revitalizing local seed systems as the foundation of local food systems



WHAT IS A SEED LIBRARY?

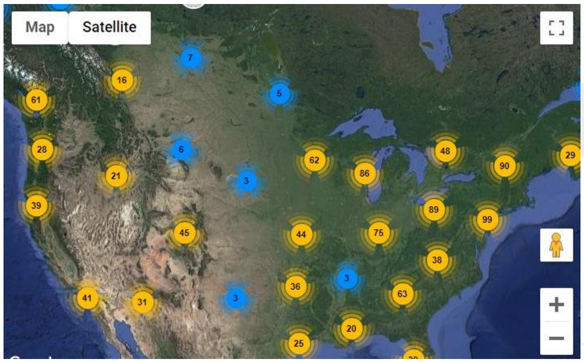
A seed library is a public collection of seeds where anyone can "borrow" small quantities of seeds and grow them out. If the resulting seeds are saved, some of them can be returned to the library for the next grower! Seed libraries are usually small-scale, focused on education, outreach and community building … and they often run on volunteer power. Why not volunteer to gain even more meaningful engagement with seeds and seed saving?

EXPECTATIONS

As a seed library member, you're part of a community where:

- everyone is welcome and encouraged to learn
- beginner seed savers will find resources to

In addition to these resources, the site includes an interactive map on which individuals and organizations can place themselves and their projects, select identifiers such as "seed saver," "community garden," "speaker," and "mentor," and can find others in their region and globally with similar projects, interests, resources, and knowledge.



Guided by co-chairs Jeanine Scheffert of Seed Savers Exchange and Steph Hughes of SeedChange, in addition to an advisory council of eight inspiring community seed leaders across the US and Canada, the CSN is growing in both scope and number of members. We invite you to go to www.communityseednetwork.org, put yourself on the map, use the map to find others in the seed community, and utilize the free downloadable and printable seed saving and seed organizational resources in any of your non-commercial seed work.

The Marketability of Indigenous *Cucumis melo* Picked Immature as Cucumbers

Jay Tracy, Cucumber Shop

From at least the time of ancient Egypt, cucumbers were known to much of Africa, the Middle East and then later Europe as a *Cucumis melo* - a melon that was picked immature as a cucumber. However, sometime after around 500 AD with Islamic conquests into Europe, the *Cucumis sativus* became the preferred cucumber - most likely because of its ability to excel in cooler climates and because of its superior storage qualities. During the time that *Cucumis sativus* established itself in Europe and later America, groups of indigenous farmers and gardeners in the warmer areas of Africa, Europe and Asia continued to grow and refine immature melon varieties to meet their local needs. However, immature melons grown as cucumbers were relatively unknown in America until the late 1800s to early 1900s, when immigrants from Armenia brought seeds of one immature *Cucumis melo* varieties into California. While some gardeners did enjoy growing these "Armenian" cucumbers, the light-colored cucumbers that would grow up to several feet long and when mature would weigh as much as a newborn were viewed much more as an obscurity then as a highly marketable product. For various reasons, the viewpoint that immature melons grown as cucumbers are more of an obscure specialty variety continues to dominate the majority of the vegetable seed community. So, why are market growers hesitant to grow what I would call "cucumber-melons" and what are solutions that can remedy this concern?

The primary concern in marketing immature melons as cucumbers is that many Armenian cucumbers lack uniformity in their size, shape or quality. Unfortunately, extreme variations in fruit size, shape and texture come as the result of seed growers – who may view such a low-value variety as not worth the resources needed to improve it. If seed companies were able to shift this paradigm to at least look for higher quality varieties, they would realize that there are already highly marketable cucumber-melon varieties available in other parts of the world. One Italian Company, the San Rocco Cooperative, currently earns the majority of their 3.5 million euros primarily by selling immature *C. melo* cucumbers. While some of the success of this company can be attributed to their work to select and advertise a high-quality product, the majority of the reason why this company has thrived can be attributed to the work done by indigenous growers.

While the rest of the world had forgotten cucumber-melons millennia ago, indigenous farmers in the Apulian region of southern Italy were selecting cucumber-melons for traits such as color, shape, flavor and overall quality. Their vegetables were not just important as food for their own families, but would bring a very good price at local markets throughout the late summer. For centuries and generations these growers would maintain, improve and preserve these cucumber-melons, but the seed of these varieties was seldom available to growers within Italy or the rest of the world until recently.

What do indigenous farmers in a small pocket of Italy know that the majority of the world does not? Imagine a cucumber that is highly productive even in inhospitably hot dry climates. The fruit of which is both consistently bitter-free and easy to digest. Skin that is thin and a flesh that is crisp, yet tender. Instead of an aftertaste that is slightly bitter and sappy, the aftertaste of this cucumber-melon is reminiscent of a mildly sweet melon. To top it off, imagine multiple iterations of this cucumber that have their own unique shape, pattern or color. A few of these varieties that have a rich complex flavor can be considered nothing short of gourmet.

Such a cucumber does exist and is already available. Often referred to as “carosello” or “barattiere” these cucumbers have proven their worth for a few market farmers throughout the United States and will likely continue to expand into more markets as consumers experience a cucumber that exhibits both a beauty and a quality that cannot be matched by conventional cucumbers.

In the last couple years, I have worked with a couple market farmers to test the marketability of these cucumber varieties. For the most part, the results have been very positive. Every time a new product is introduced into a market, it can take time for customers to become accustomed to it. Initially, these cucumber-melons do not sell well, because of a lack of knowledge. Providing sample product to begin with works well but is only an initial investment. The excellent taste, texture and the ability of these cucumber varieties to stand out at the market not only brings customers to look at the cucumbers, but more often than not enables market growers to sell out quickly or at a premium.

As with all the vegetables that we currently enjoy, I am grateful to those growers who saw the value of growing cucumber-melons. They valued these immature melons enough to invest the time and energy required to bring us both nourishment and quality that - though forgotten by much of the world - will hopefully never be lost again.

https://www.meloncella.it/la-cooperativa.html

https://www.freshplaza.com/article/9232192/caroselli-and-barattieri-are-preferred-to-the-common-cucumber/

Seed Saving and Climate Change

Andrea Berry, Montana State University SNAP-ED

Extreme weather events are occurring now with greater frequency and intensity than in previous years. Scientists in multiple disciplines are in consensus that this is the result of human-caused climate change, exacerbated by the loss of biodiversity and shrinking natural habitats. The temperature of the entire planet is warming, causing more volatile weather worldwide. Extreme weather is likely to increase in frequency, duration and intensity in coming years as a direct result of climate change, which will affect humans in multiple ways, one of the most important of which is in global food production (IPCC Report, 2021).

Considerable research has been done on the effects of extreme heat on plants, particularly food-producing plants. Plants experiencing extreme heat can lose a variety of biological functions, which can result in a reduction in yield and productivity, overall biological impairment and/or higher mortality (Schlenker & Roberts, 2009; Hatfield & Praeger, 2015; Schauberger et al., 2017; Peterson, 2019). Many food -producing plants have optimal growing temperatures between 80-95 degrees Fahrenheit, so that the threshold for extreme heat can be lower than imagined. While plants are able to tolerate some higher temperatures for brief periods without incurring serious harm, higher or prolonged temperatures can badly damage plants and their ability to produce food (Giordano, Petropoulos & Rouphael, 2021).

For those plants that are insect pollinated, there is an additional concern. Pollinators are susceptible to extreme heat, too. The most studied pollinators are bees, many species of which demonstrate sensitivity to high temperatures (Maebe et al., 2021a, Maebe et al., 2021b). Bumblebees develop hyperthermia which can lead to infertility in males and/or death to both genders at temperatures of 104 degrees F (Martinet et al, 2020a, Martinet et al., 2020b). Pollinators have a reciprocal relationship with plants such that if one is damaged, both are affected, producing ripples across both species and extending to others (Gerard, Vanderplanck, Wood & Michez, 2020).A plant that can survive extreme heat may produce nectar and pollen in smaller amounts than normal, so that bees avoid the plant, or the plant may produce them at unusual times that are at odds with the timing of the pollinators' needs, so that the reciprocal relationship fails and neither plant nor pollinator thrives (Rafferty, 2017).

The actions that can be taken to moderate the effects of extreme heat on plants and pollinators immediately that will affect both current and future production are to increase access to natural habitat and food sources for native pollinators. Planting native plants and trees and providing nesting habitat free of chemicals will support pollinators when weather conditions are stressful (Laws, Jepsen, Code & Black, 2019). Gardening in more sheltered locations with partial shade can moderate the effects of extreme heat for plants, along with the use of shade cloth and plenty of water. Even fields can benefit from added perimeter protection through tree and shrub planting and native pollinator habitat enhancement.

What is done today will provide both immediate and future benefits. As more volatile weather increases in frequency, any elements that provide stabilization for ecosystems and the components of ecosystems will enhance the capacity to grow food plants successfully and encourage higher yields of crops, whether of food or seed. Supporting pollinators, providing shade and shelter for plants and observing what works best locally and in individual microclimate locations will help facilitate continued food and seed production.

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Seed Demonstration Farm in the Heartlands: Meadowlark Hearth seeks applicants

Nathan and Beth Corymb

We are looking for experienced seeds people to take on growing, trialing, selecting, handling, distribution, development, business, and managerial aspects of Meadowlark Hearth Seed as we transition to a small homestead level of growing, saving and breeding seed. Ideally, we see the transaction taking two to three years as we train and hand on ownership, assets and responsibility.

Nathan and Beth Corymb are located on land that was home to the Lakota and Pawnee people, who did not own the land, but shared it with all its living inhabitants (Mitakuye Oyasin). Like them, we as "landowners" need to put our efforts toward a shared future for the earth and all its inhabitants. They are the reason there is heart still in the Heartlands. We, as descendants of European colonizers several generations ago, are somehow privileged to now be caring for this 540 acre farm which Beth Corymb's grandparents first homesteaded it in late 1800's as a hay farm for the nearby dairy. Nathan's parents and grandparents also farmed in the mid-west. Both of us honor what our ancestors did and yet, for the sake of Mother Earth, we recognize the folly of land ownership.

Meadowlark Hearth Farm is in the panhandle of Nebraska, 25 miles from the Wyoming border, 1.5 hours northeast of Cheyenne, 2 hours from Fort Collins, CO, and 3 hours from Denver. Annual rainfall averages 12 inches, and there are occasional strong winds and ferocious hailstorms. The dry high plains climate at 4,000 ft has large temperature swings, from subzero spells to balmy thaws in the winter, and 50-60 degrees nights in high summer with daytime highs of 85 to 105 degrees. It's a roller coaster climate, yet this builds resilience in the seeds grown here (as well as the animals and people).

The nearest towns are Scottsbluff and Gering facing each other across the North Platte River. They are 5 minutes away with a combined population of about 22,000. Scottsbluff county has a 30% Hispanic population, 5% Native American, 63% white European and a smattering of other ethnic groups. Pine Ridge Reservation is just over 2 hours to the north. Agriculture in the area is largely commodity crops (corn, sugar beets, dry beans, alfalfa and grass hay, and dryland wheat) with extensive range lands for cattle and several feedlots.

Vegetable Seed Growing in Western Nebraska, Zone 4, 4000 ft. High Plains

Vegetable seed growing has real potential on this farm. We have grown most vegetables to seed here successfully with the exception of cauliflower but we are going to try a little of that in 2022. Below, there is a general overview of what we have learned in our first 12 years of seed growing at Meadowlark Hearth Farm, western Nebraska, zone 4, high plains, -20 F below winter and up to 105 F summers. Assets of growing in our climate include 12 inches of annual moisture, subzero winters, hot summers. Challenges of growing in our climate include very basic soil, 7.5 to 8.5 pH.

Best Practices for Growing Biennials to Seed in Western Nebraska or Zone 4

Onion disease issues almost nonexistent, no purple blotch. Overwintering helps select for storage hail, wind, bindweed or convolvulus, weed out bindweed, harvest seed prior to seed formation of convolvulus use hail cloth or grow in hoop house and then use pollinators or meat to hatch out pollinators, weed well.

Leeks are disease resistant in dry climate winter leeks have no problem overwintering but summer leeks have too long a requirement for seed ripening for our short season so better to leave in ground so they can get a head start in spring. Use an electric heating line on the soil for summer leeks seed biennials in order for them to begin early in the spring to grow and have enough time to properly form seed.

For carrots, there is no Queen Anne's Lace (wild carrot) because of altitude and aridity, so the wild carrot does not easily naturalize here. Six carrot varieties successfully grown here. Carrot fly became a problem when we grew overwintered parsnip. Cover carrots with pollinator excluder in spring plantings, always pick up carrot tops (feed to cows). Put carrot parts into refuse pile, not in compost, or promptly feed to cows.

For celeriac, the dry climate keeps disease away. Carrot fly became a problem when we grew overwintered parsnip. When selecting for seed, select roots which do not have fly damage.

No wild parsnip naturalizes so care has to be taken to eliminate self-sown parsnip plants that harbor carrot fly. Dig out self-seeded roots to prevent crossing and harboring carrot fly.

The dry climate helps cabbage or kohlrabi. Five cabbages, two kohlrabi varieties grown here. Harlequin beetle showed up in 2015 but population appears to be decreasing. Vacuum insects each day when appear. Note insects, test for seed borne disease. Best to cut heads in autumn so there is time to make little nodules which will form the seed branches in the following spring.

For broccoli, the dry climate and harsh winter requires us to treat it like an annual, so broccoli is not as good a selection as it would be in a more conducive mild winter climate. Treat like an annual, begin in January. Grow no other flowering *Brassica oleracea* within 1/2 mile.

We are still learning how to grow kale to seed in this harsh winter climate, but we have succeeded with one variety Kale has less plant mass so harder to overwinter than cabbage, however, planted in spring year one and leaving it until year 2 in a protected place works to ripen seed. It is best to plant it in a protected place where it can overwinter instead of moving it like cabbage.

There is no overwintering of sugar beet here to cross pollinate with beets or chard. Embryos of chenopod family need no more than 90 degrees when forming. Swiss chard more difficult to overwinter than beet. Use electric cable to keep temperatures above freezing in order to plant out early and take advantage of mild early summer temperatures for embryo formation.

Best Practices for Growing Annials to Seed in Western Nebraska or Zone 4

This is a great sweet corn growing climate, though GMO corn is grown all around the area. Sow corn prior to field corn, cover, then monitor when it tassels and when field corn tassels. To dry, put on a corn board. Send a sample to a company that can look for GMO crossing.

Tomatoes, peppers, eggplants can be grown on a larger scale. The dry climate helps with avoiding disease. Millet thresher had painted galvanized metal which produced paint chips when wet seed was put through it, stored millet thresher in barn. Timothy Wood rebuilt our millet thresher to have stainless steel for the holder and screens, so no more paint chips in seed!

For cucumbers, melons, and squash, the dry climate helps avoids disease. Cucumber beetles can carry and spread cucurbit diseases. If disease is noted early in a squash crop, then it is probably seed borne. If disease is noted later in the season, it is probably environmental. Vacuum squash seed out of cavities, melon and cucumber seed scooped by hand.

Lettuce, sunflowers, endive are mostly self-pollinated, so isolation distance required is not too far. Wild lettuces can cross into lettuce population, so it is best if it is isolated at least 100 feet. It takes time to scout for wild plants. Make sure that your lettuce seed crop is not near wild lettuce, because insects can sometimes cross them.

For alfalfa, beans and peas, the dry climate keeps disease at a minimum. The high soil alkalinity can be a challenge for the legumes. Keep working on humus development to sweeten soils.

For spinach, the dry climate helps to avoid disease. Plant outside and cover in October. Embryo formation needs cool temperatures. Sow spinach in October for larger scaffolding prior to going to seed in early June

Meadowlark Hearth Farm – 550 Total Acres

138 acres of riparian wildlands along the North Platte River with Cottonwood savannahs interspersed with Russian Olive, Ash, Willow and Box Elder. It is owned by the Living Environment Foundation and managed as a nature preserve, with hopes and plans to start a nature awareness, primitive and native skills program for children and adults.

332 acres are pasture and hay ground for our 50 head grass fed/grass finished beef/dairy herd. It also includes an isolation garden and hoop house a mile from the other gardens. Lots of wild animals live on these combined 470 acres, such as deer, coyote, eagles, badgers and prairie dogs.

80 acres to the north are separated from the rest of the farm by a highway and railroad tracks. This section has most of the building infrastructure for growing vegetables and vegetable seed, drying and cleaning seed, climate controlled storage for seed, vegetables and biennial root stock (for 2nd year re-planting). Drying of onion bulbs and garlic seed happens in the century old wooden barn. There is an indoor seed lab set up and equipped for germ testing. There is a farm workshop, two houses, a basement apartment, and several nice building sites.

There is a 96x24 ft hoop house and an attached 14x24 ft greenhouse at our house for starts. Our tall south facing windows allow us to do very early starts inside our house from mid-winter to early spring. We sow the allium transplants directly in the hoop house ground. We are well equipped with tractors, haying, tillage, seeding and transplanting tools and implements. Irrigation happens with drip lines for the seed and vegetables and flood irrigation for the hay ground. There is a milk house, milking parlor, milking machines and several freezers and coolers for the animal products.

Animals Helping with Seed Health and Garden Protection

All animals on the farm are working with us. Compost piles from cow manure and bedding are made annually. Not only does our herd of 50 cows provide compost for the fields, but they love our leftover vegetables. We feed the vegetables in a special spot in the cow yard and compost separately in a refuse pile with leftovers, weeds, and seed cleaning and garden refuse. This pile composts for about 5 years and is spread on outlying pastures. The interplay of plants and animals is critical to the health of the farm and the seed. This cycle from plant to animal to compost helps greatly to prevent the persistence and spread of plant diseases. The chickens too play a role. We bring plant material with insect damage for them to pick through as they are moved in the animal pastures during the summer, and they clean up the hoop houses in the winter. Our cats are mousers and our Great Pyrenees dog, Thelma, guards the chickens in the day and works nights to keep the deer and raccoons and away from the vegetables on the 80 acres.

How Market Gardening and Seed Growing Go Hand in Hand

Folks in our area are more oriented to box stores, organic farming being foreign to them, but we have a small CSA as well as marketing vegetables and seed to co-ops in Colorado. The vegetables that are dual purpose are peppers, melons, squash where we have gone into the public schools, using their certified public school kitchen, prepping the vegetables for their meal and taking home the seed for further processing. Also growing the veggies, helps to trial the seed that one has grown.

For the Future of Meadowlark Hearth Farm

While Beth is the fourth generation of her blood family to be involved in farming on this land, Nathan and Beth intend for this land to go out of the family and be available to capable and willing hands to continue the Biodynamic open pollinated seed work. We hope that programs developed here will demonstrate and educate about how seed grows, and how it has developed out of all the world's cultures. We are looking for a few passionate, capable, and daring partners who would like to join our work and take it on. We are striving to make the assets/infrastructure built up so far for seed work and the whole farming available to the right few people who can then expand from there. As aging farmers we wish to share our experience while we still have the physical capacity and mental acuity to do so. The land will go into a land trust and we are actively working with Agrarian Trust to set up an Agrarian Commons to accomplish this. The business will continue. When the time is right and the right people come forward, it will be given with its equipment, infrastructure and assets to that group of people.

There can be other businesses and social striving entities that develop here. Some ideas are a local recycled product and job producing entity, https://preciousplastic.com/, helping young people who have aged out of the foster care system and helping them heal by seeing plants growing to seed and cows having calves etc.

Our Underlying Philosophy

We are a Biodynamic farm following the guidelines of Rudolf Steiner. We also try to follow his threefolding concepts as a farm community (freedom for individuals, equality in community, brother/sisterhood (creaturehood) in economics). Recommended reading: Steinerian Economics by Gary Lamb and Sarah Hearn. This needs people willing to work with community, i.e.: working with and for each other to have a joyful, interesting meaningful vocation. It requires individuals with the capability for compassion and a deep interest in one another.

This said, we are open to people of all faiths, philosophies, and pathways, as spiritual freedom is a key concept of the threefold social order.

The Invitation

Applications for partnerships or visits to learn what we are doing:

We need to have 5 references and an essay answering the following questions (in case you are applying as a couple, we need an application and references for each individual):

1. Why you are passionate about seed?

2. What experiences make you a worthy candidate for partnership here in seed work?

3. What community experiences you have had?

4. Future of farming and what it means for the earth?

5. Other experiences in ecological efforts?

6. What experiences you have had with organic and Biodynamic Agriculture?

7. What do you know about Threefolding ideas of Rudolf Steiner and practicing them

The opportunity is here for the people suited for the challenge. Please send inquiries to: meadowlarkhearth@gmail.com and call 308-631-5877

Connecting Community Through Seeds!

Laura Garber, Cultivating Connections Montana

Sharing food, farming, and seed saving with our communities brings so much to everyone. Many people have no idea how food grows, and even fewer people have knowledge or understanding about seeds. By inviting the community to our farms, we can inspire people. By showing them where and how we grow food and seeds, by letting them touch, taste, and smell our plants, and by teaching them some very basic things about seeds and plants we bring them into our world. As farmers and seed growers, we have so much to share. We also have a lot of work to do!

Here is some of what I am doing to engage and to teach my community, using the plants, and the seeds. I hope this inspires you to broaden your connection to community by sharing more of our amazing seed-nerd, food-grower world! To help introduce the community to seeds, without taking a lot of my time, I scheduled a series of three, short field day events at our farm. To introduce people to food plants, I designed a project to give away whole gardens worth of plants to families and community members.

The first seed event, held in late April, admittedly took the most organization. "Spring on the Farm: Knowledge-sharing with local growers" was aimed at backyard beginners. We had five "how-to-do-it" short sessions led by local grower volunteers. I led the session on seed saving, sharing just the very basics about how plants reproduce, how they make seeds, and some suggested plants to start with. We looked at young plants together. I encouraged participants to start immediately with something! The handout I created is below, hopefully it is all correct.

Topics at "Spring on the Farm: Knowledge-sharing with local growers" were "How to Raise Chickens, Where to start", "How to Take and Plant Willow and Other Plant Cuttings", "Composting and Soil Health Basics", "Introduction to Organic Gardening Concepts", "Introduction to the World of Seed Saving!".

The second seed event was held in July. "Seed Walk with Farmer Laura" was aimed at the general public. It started with a motivational talk about how seeds connect us to each other, the past, and the future. Then I shared the same basic information about plants and how they produce seeds. We walked around the farm together, stopping at every seed crop. While looking at each crop I described the plant's basics and pointed out things like the insect pollinators roaming the flowers, and pollen wafting off the plants. I encouraged participants to look closely at each planting and to notice as much as possible.

The third seed event was held in October. "Seed Saving with Farmer Laura" was a collaboration with the Community Food and Agriculture Coalition of Missoula, Montana. It was aimed at the general public and gardeners. It started with a motivational talk and a review of the basics. We looked at all the bags of seeds hanging to dry in our barn and talked about the basics of each seed crop. Each participant was given a paper bag. We then walked through the fields, stopping at all the seed crops. We had already harvested most of the seeds, but there was plenty left for everyone to touch, inspect, and collect in their paper bags. I encouraged participants to take some of everything. Even if they were not in a space to plant them or even remember which seed was which, just having the seeds to look at later gave people a deep sense of connection! We ended by looking at our seed cleaning equipment and giving a demo of how to thresh seeds and winnow using a very simple box fan set-up.

Below is the information I shared with participants, as well as the outline for my motivational talk. Please feel free to copy anything that is useful for you. It is easy to share seed saving with your community, inspiring for participants, and important for the seeds! Thanks for sharing.

'Mayday! Gardens' is our covid-inspired program to introduce people to plants and food. With our Youth Farm Interns, we now plant, grow, and give away thousands of seedlings for food plants – all the seeds we grow for seed for Triple Divide Organic Seed Cooperative. Mayday! Gardens, as in "Mayday! Mayday! We need to grow food and keep seeds!", also brings to mind the spring rituals of renewal that are fun and inspiring. By using our own seeds, we can teach people how to grow some of their own of produce and flowers. These plants come from our own favorite varieties. They do well for our area, so we feel confident giving them out to beginners or experienced gardeners. It doesn't cost much for the soil, and with volunteers, the seeding, thinning, and distribution are joyful and educational. Best of all, it is fun and easy to teach people how to start saving seeds from many of these plants!

Below is the planting guide I put together. I hope it is helpful for you to get your Mayday! Gardens started for your community!

Introduction to the Basics of Seeds

Basic Plant Reproduction

- Annuals produce seed in one year ex. Lettuce, beans, peas, dill, cilantro, calendula, radish, sunflower, tomatoes
- Biennials produce seed the second year ex. Carrots, beets, onions, cabbages

Pollination methods

- Self pollinating (Selfers), closed flower ex. Peas, beans, tomatoes
- Wind pollinated ex. Beets, corn (smooth, light pollen)
- Insect pollinated ex. Cabbage family, carrots (sticky or barbed pollen)

Dioecious or Monoecious

- Dioecious plants-such as hemp, spinach: each individual plant is either female or male
- Monoecious plants- many plants: each individual plant has both the male and female
- Squash family have monoecious flowers: each flower is either male (staminate) or female (pistillate)

Easy Plants to Start Saving Seed Now

Broccoli, lettuces, beans, peas, tomatoes, calendula, dill, cilantro, radishes

First Steps

- Grow several of the plant you want to save seed from
- Rouge out/cull any that do not look right or become diseased
- Tend over the summer
- Harvest seed heads in the fall, protect mature plants from fall precipitation

Planting Details

- Broccoli- start as early as possible, seed or transplant outside late April till early June. Harvest main head and enjoy, then let the side shoots flower away.
- Lettuce- seed or transplant outside late April through early July
- Peas- seed outside through late July, harvest the very first peas to eat
- Beans- seed outside through late June, harvest the very first beans to eat, protect from freezing late season
- Tomatoes- collect the inner juices of a delicious tomato and save the seed
- Calendula- seed outside through mid June, collect seed heads
- Dill- seed outside through mid June, collect seed heads
- Cilantro- seed outside through mid June, cut once to eat, then let grow to seed
- Radishes- seed outside through mid June, thin to one Shaka between each radish and let grow to seed

Plan for Next Year Now!

- Seed Carrots and Beets in late June, store over winter, and replant in spring and let them grow to seed!
- Seed cabbages or kales in mid August/transplant in late September, protect over winter and let grow to seed in spring!

Mayday! Gardens Planting Guide

Thank you for participating in Mayday! Gardens. Have fun planting, caring for, harvesting, and eating 'Your Future Food'! Congratulations on taking part in creating resilience by growing some of your own food.

Herbs and Flowers

- Red Clover- perennial that will regrow every year. This can be planted anywhere in your yard or garden and will take up about 2 square feet (4 shakas) when fully grown next year. Harvest the dark pink flowers for use as a tea- fresh or dried. Delicious and supports female health.
- Borage- annual that produces tasty blue flowers. Needs 2 shakas.
- Calendula- annual that produces lots of yellow or orange flowers. The petals add beauty to salads, make a nice tea, and can also be used medicinally. Leave every third flowers to ripen its seeds to replant in future years. Needs 1 shaka.
- Nasturtium- annual that produces spicy flowers that are fun to eat. Needs 1 shaka.

- Dill-annual herb whose leaves are delicious chopped into lots of foods and whose umbrella-shaped flower and seed head is used in pickling. Needs 1 shaka.
- Sunflower- annual flower that can grow really tall! Sunflowers are our reminder that we are all together as one humanity- and need our own food resilience. Needs 1 shaka.

Vegetables and Greens

- Kale- the powerhouse Brassica packed with nutrition and the most adaptable to Montana weather changes. There are several different leaf types- from dark purple to frilly green or dark blue-green leaves. Harvest and enjoy weekly until late fall, but remember to always leave the inner 3 small leaves for regrowth. Needs 2 shakas.
- Chard- related to and tastes much like spinach, but it regrows! Great raw for 'spinach' salad or cooked into any food. Use the chopped stems to add crunch to salads or color to cooked dishes. Leave the inner 3 small leaves for regrowth. Needs 2 shakas.
- Kohlrabi- grows a Brassica bulb on the soil surface that can be harvested at baseball to softball size. Peel and grate into salads or dice into cooked dishes, sort of like jicama when chopped and eaten raw. The leaves can be eaten like kale. Young kohlrabi plants have jagged leaves. Needs 1 shaka.
- Cabbage- Brassica known for its starring role in coleslaw and sauerkraut. Slice off sections to eat raw, cooked, or femented-the whole head will keep in your fridge's crisper drawer for three or more weeks. Young cabbage plants have very rounded leaves. Needs 2 shakas.
- Broccoli- likely the most famous vegetable, also in the Brassica family. Harvest the main head and leave the plant, letting it grow small side shoots for on-going harvests. Young broccoli leaves are lobed. Needs 2 shakas.
- Lettuce- the best carrier for delicious salad dressings! Harvest outside leaves for weeks, cut leaves very short 2-3 times, or let grow into a full-sized head. Needs 1 shaka.
- Onions- plant in pairs, harvest when baseball size, or by the middle of October. Can be stored in a cool, dry place for 2-3 months. Each pair needs 1 shaka.
- ***Bush Beans- super easy and can be harvested again and again. Each plant needs ½ to 1 shaka.
- ***Cucumbers- super sensitive to transplant shock so plant into very loose soil and firmly pack the soil around the plants. 2 to 4 plants per hill. Each hill needs 6 shakas.
- ***Summer Squash- put seeds as deep as your thumb into the soil and keep moist until the leaves are out. Wear long sleeves when harvesting as the undersides of the leaves can be scratchy. Harvest regularly or they will get big before you know it! Each plant needs 6 shakas.
- ***Heirloom Tomato- short seasoned, determinate plants will produce round, red tomatoes that are full of flavor and adapted to the short summers of Montana. The tomatoes in your Mayday Garden do not need a cage or a stake. In case of early fall frost, cover with a bucket at night, or pull the whole plant and hang in the garage so tomatoes can ripen. Each plant needs 2 shakas.

*** = Vegetables that need a bit of extra care and protection from spring frosts

Before going to bed, cover young plants with bucket, bowl, or sheet if temperatures are predicted to drop below 32 degrees or if there is a frost warning. The coldest time of the night is usually the early morning, just before sunrise.

Measuring with the Shaka

The shaka, that Hawaiian hand signal for “hang loose”, is the distance between your outstretched thumb and pinky finger (about 6 inches for an adult). “1 shaka” means each plant needs to be at least one shaka distance away on all sides from other plants. “2 shakas” means the plants needs two shakas of distance in every direction from other plants. Elementary school children should double the number of shakas. If your hands are small, add a bit extra on either end of your shaka. It is easy to teach and is an easy guide for planting distances, helping ensuring success.

Advice from a Farmer

Plant “Your Future Food” carefully and with mindfulness for the gift of resilience that food plants share with us. Tuck the plants into the soil, making sure all the original soil as well as the edges of the planting pot are completely covered by your garden soil. Water “Your Future Food” plants after you plant them, making sure to keep them moist for the first two weeks.

Tend Your Future Food with care and attention. This does not have to take a lot of time but does require a consistent schedule of watering, cultivating, harvesting, preparing, and also eating!

Make spending time maintaining Your Future Food the highlight of your day. Caring for plants feeds our need for connection, and aligns us for co-creating a healthy future: a world that works for everyone.

Adopt an attitude of open discovery. Look for new ways to understand. For example, the German definition for weeds says they are just plants growing in the wrong place at the wrong time!

Connect with Your Future Food plants. Start by appreciating their ability to grow as you watch them take hold in your garden. Smile at the creative and beautiful way nature uses chlorophyll to turn sunlight into leaves you get to eat! Thank them for growing, and thank them when you harvest Your Food.

When saving seeds, know you are part of a lineage of seed caretakers who have shared these food plants with the following generations for as long as humans have been growing plants. This is a very special thing. Your grandmother probably did it, your great-great grandmother definitely did it, and every grandmother before her also saved seeds. Have Fun and Eat Well!

Dear Farmers And Gardeners! An Invitation to Participate

Join us in growing for a widespread food-plant distribution day on June 12, 2021. Mayday! Garden invites you to grow plant starts - to tend yourself, to share with your friends and neighbors, and to plant in your area. It is easy and fun to grow food plant starts. First, pick the day you want to distribute your plants. From that date, count weeks backwards to determine when to seed each type of plant. Your latest distribution date should be no less than 80 days before the anticipated first frost date in the area where they will be distributed. Find containers, dig up some soil, and get seeding!

- 6 weeks before distribution: seed swiss chard, tomatoes
- 5 weeks before distribution: seed kale, cabbage, broccoli, kohlrabi, calendula, nasturtium, dill, lettuce
- 4 weeks before distribution: seed pac choi, Chinese cabbage
- 3 weeks before distribution: seed winter squash, zucchini, cucumbers, and bush beans
- 2 weeks before distribution: transplant tomatoes into larger pots

Dear Neighbors! Invitation to participate

Mayday! Mayday! Mayday! Gardens - the food, soil, and seeds need our attention now. Mayday! Mayday! Mayday! Gardens - growing together for local food and societal resilience.

This is a supported journey into small-plot agriculture, gardening, food, and seed saving. Free, ready-to-plant vegetable, herb, and flower starts selected for easy growing in Montana. Informative and fun videos will help you be successful. Everyone is invited to join Mayday! Gardens to plant, harvest, and eat together. No gardening experience necessary, Everyone can grow food!

We will grow food and we will release ourselves from the current system of Corporate-Industrial-polluting-Slave-driven-gene-manipulated-subsidized-unhealthy Agriculture-as-a-profit-driven-Big-Business. We will create a food system that is abundant, fair, healthy for consumers, farmers, and the planet, and is locally focused. We will build our soils, our health, our community, and our future. “Change Your Food, Change Your World!”

How and where you plant Your Future Food is only limited by your imagination. A small, 4’X6’ square will work, a 1’wide strip that is 24’ long will work, planter boxes, large patio pots, and raised beds will work. Just plant your future food, please. Mayday! Gardens can be in your front yard, along the driveway, in a community garden plot: anywhere with soil, sunlight, and a way to get water.

Preparing to grow Your Future Food is easy. All you need is a shovel, a garden fork, or a rototiller. Maintaining Your Future Food is fun and easy. All you need is access to clean water and a bucket, watering can, or hose. It will be rewarding to care for your plants, will give you a bit of exercise, and will not take a lot of time.

Harvesting Your Food will be the best fun, and your Food will taste incredible! Preparing it into delicious and healthy meals will be easy. We’ll share tips to help you be successful including recipe and meal ideas, designed especially for the vegetables in your Mayday! Garden.

www.cultivatingconnectionsmt.org

www.globalfarmersassembly.com

(406) 363-6627, cultivatingconnectionsmontana@gmail.com