



Seeds

by J. A. Ginsburg

*"Every time you teach somebody else how to save seeds
you're voting for the future because the more skills we
have, the better the future looks"*

– Alys Fowler, gardener

*"The first time I saw a collection of beans it was, 'Whew!' A jewelry store.
I lit up and have always just been dazzled by diversity... Genetic diversity
is hedge between us and global famine."*

– Will Bonsall, seed saver

*A seed is a doorway between the life of an old plant
and its gift to a the new plant.*

– Dennis Klocek, biodynamic gardener

*"We just don't have the time left on this small planet to recreate all
this stuff. That's why it's so invaluable.*

Once it's gone, it's gone"

– Bill McDorman, executive director, Rocky Mountain Seed Alliance

*"We need to know about protecting our seeds and foods... to protect the sacredness
of our culture... They're not inanimate objects for us. The word for corn, o·n'áste',
is closely related to the word for breastmilk. That's how intimate a relationship it is,
and how closely we're connected."*

– Lea Zeise, the Intertribal Agriculture Council

"Whatever happens to seed affects the web of life."

– Vandana Shiva, food sovereignty advocate

*"If there's no one to pass that seed onto, that
living link and that living seed is lost."*

– Diane Ott Whealy, founder, Seed Savers

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ORIGINS

Seeds are the beginning and the end of the story: We plant seeds to get more seeds.

Everything we eat either has come from a seed (fruits and vegetables), is itself a seed (grains), or is one degree removed from a seed (meat, poultry, dairy). From seeds come materials that clothe us and shelter us; compounds that heal us; flowers that cheer us; and spices that literally add spice to our lives.

Yet flowering plants, the source of most seeds, are a surprisingly recent development in Earth's 4.5 billion-year history. On one very, very special day, sometime between 125 million and 140 million years ago, [the first flower](#) bloomed in what is now China. And a brooding planetary landscape long dominated by dark green coniferous forests and giant ferns would, in short order, be covered in flowers, kissed with color, perfumed with scent, and filled with buzz, hum, croak and song of trillions upon trillions of pollinators.

Some plant species are divided into males (producing pollen) and females (equipped with a structure called a pistil), while others combine the sexes. Some plants self-pollinate, while others cross-pollinate. All rely on wind, or the industry of nectar-loving insects, birds and other animals, to get the procreative job done. The result is a seed, a living embryo that connects one generation to the next.

Seed dispersal relies on water as well as wind and animals. A seed can travel far gliding on a breeze, swirling through the eddies and ripples of a stream or hitchhiking, buried in fur or feather.

To germinate some seeds require a literal baptism by fire. Others must first be frozen, or soak in water, or travel through the guts of an animal, a process that not only softens a tough seed coat, but transports the seed and finally deposits it in a nutrient-rich pile of poo.

Seeds can be quite sturdy. Under the right conditions, they can last years, sometimes centuries and occasionally millennia. When a handful of [2,000 year-old Judean date palm seeds](#) were

discovered at archeological sites in Israel a few years ago, scientists tried planting them. This once ubiquitous palm with its biblically-celebrated, famously tasty fruit had disappeared, a casualty of centuries of war, conquest and climate change. To everyone's surprise a few seeds sprouted. The male plants produced pollen which was used to pollinate a closely-related species, which then produced dates. The female Judean date plants haven't yet fully matured, but when they eventually do, it is possible that a prized fruit, rich with the flavor of glories past, will once again be on the menu.

Still, the date palm seeds are youngsters compared to a small cache of seeds of *Silene stenophylla* (a small plant with delicate white flowers) [discovered in a 32,000 year-old burrow](#) in Siberia, preserved in permafrost 124' beneath the surface (likely buried by squirrels and promptly forgotten). Remarkably, not only did this would-be rodent food germinate—with a high-tech assist—but the plants also flowered and produced the next generation of seeds. After a 32,000-year-long winter, spring finally arrived.

AGRICULTURE

It is hard to compete with the sheer seed-saving prowess of ice age squirrels, but it took another species—ours—to make the leap from enterprising gathering to intentional farming. Between 10,000 and 12,000 years ago all over the globe for the first time in history people began to plant seeds for harvest at scale. And wherever agriculture developed, it laid the foundations for the rise of complex civilizations and the emergence of villages and eventually cities. (Some think it may be the other way around—[that settlement made agriculture possible](#). Either way, the two developments dovetailed closely.)

These early farmers were accomplished, astute seed-savers, collecting seeds from the most productive, hardiest plants producing the tastiest grains and most delicious fruits. Over time wild plants that were selected for these practical and satisfying traits became domesticated. This is how native grasses were transformed into staple crops such as corn, wheat, rice and barley.

The transformation process was just as profound for humans. A more predictable—and predictably nutritious—food supply changed people physically. Agriculture enabled populations to grow and as people began to settle in villages and cities social structures changed. Culture—art, music, dance, religious ceremonies and spiritual traditions—were animated by the urgency of a bountiful harvest.

“Corn is really this beautiful co-creation between plants and humans,” notes Rowan White, a member of the Mohawk Tribe and Creative Director of [Sierra Seeds](#). “The incredible evolutionary leap we took with corn is a miracle.”

It took less than 5,000 years for corn-based agriculture to spread from the Oaxaca valley in southern Mexico north to what today is the US border. It continued to spread up the coast until 1,000 years ago when suddenly corn was everywhere across the entire North American continent. Corn—each kernel a seed, efficiently packaged in cobs, protectively wrapped in husks—was a game-changer.

When Columbus “discovered” the Americas, he discovered corn, too. In the time it took a ship to cross the Atlantic, corn was now in Europe. And from there it spread across the world.

From the Middle East to Africa, from the Americas to China, Korea and elsewhere in Asia, wherever agriculture took hold the story was the same: People domesticated plants and were, in turn, domesticated. A wild past gave way to a civilized, uniquely human future.

THE COLLECTORS

Once the basics of agriculture had been mastered, the focus shifted to making a tastier dinner. Although the line between gathering and collecting can be a thin one, in general the former addresses basic needs, while the latter can inspire cuisines and even build fortunes.

Take, for example, the tomato. No one knows whether it was Jesuits or conquistadors who brought this delicious native of Mexico to Italy in the 16th century, but didn't that turn out well? Mexican and Italian cuisines couldn't be more different, yet hold in common an ingredient whose versatility seems to know no bounds.

Or consider the potato, another American find that would go on to change the course of European—and world—history. In the 1530s Francisco Pizarro, the Spanish conquistador best known for finding, then promptly plundering, the Inca Empire in the Andes mountains of what is now Peru, sent several varieties of potatoes back to Europe. Although only a footnote to the massive haul of looted gold and silver that was the point of the expedition, over time these humble spuds would prove the far better investment. [In 2019 the global potato market topped \\$140 billion](#), with 2020 expected to be even better. .

Unfortunately, the only variety to survive the long journey was the remarkably durable “lumper.” What it lacked in beauty it more than made up for in versatility. Any way you cooked it—boiled, fried, mashed, baked, diced, sliced, stuffed—delicious!

But almost every lumper in Europe was a clone, grown not from a seed, but rather by cutting up a potato and planting the “eyes” (an eye is a bud that will grow a stem and leaves). The Inca had always made sure to grow some of their potatoes from seed, which assured a back-up pool of genetic diversity in case of disaster. They had no way to know what genetic diversity was exactly —[the first gene wouldn't be sequenced until 1972](#)—but nevertheless they understood the benefits.

It is possible that the defeated Inca were disinclined to tell Pizarro's men about the finer points of potato agronomy, so the spuds shipped to Europe apparently arrived without instructions.

When a disease called “late blight” came to Ireland a little more than 300 years later in the 1840s, the identical genetics of clones meant every single potato was vulnerable. The disease (which is not caused by a fungus as is popularly thought, but rather by an oomycete) ravaged Ireland’s entire crop for four years straight. An estimated one million people died in the famine. Another million emigrated, many to the United States. By the time all was said and done, Ireland had lost as much as a quarter of its population and the scars of death, malnutrition, lost livelihoods, fractured families and altered futures would be felt for generations to come.

The famine is a cautionary tale of what can happen when genetic diversity is sacrificed for the short terms gains of cheap, seemingly plentiful food.

“The seed remembers” observes Charles “White Eagle” Barnes, a part-Cherokee farmer in Oklahoma who became famous for his “Glass Gem” corn. The iridescent kernels were the result of a serendipitous cross made when Barnes tried to “breed back” heritage varieties to bring out traits that were in corn traditionally used by Native Americans.

“The seed remembers,” means that although not every gene is expressed in every individual plant, each seed is full of genes that are biding their time. These unexpressed, recessive traits are waiting for the right moment, the right cross, to appear. It could be a gene that affects the color and shine of a kernel of corn. Or it could be a gene that makes a plant better able to withstand drought, or survive disease.

Diversity is beauty, security, resilience.

Diversity is everything.

USDA

Long before anyone knew to worry about invasive plants and pathogens, seeds were the traveler's souvenir of choice. For [Thomas Jefferson, collecting seeds was an act of patriotism](#): *"The greatest service which can be rendered to any country is to add a useful plant to its culture."* Which is how he justified risking the death penalty to smuggle rice out of Italy to grow at Monticello.

It would be another 60+ years before the young Republic would have a [Department of Agriculture](#) with a founding mission to collect and distribute seeds to the nation's farmers. That doesn't mean there wasn't an urgent need long before that.

By the 1820s farmland all along the East Coast had lost fertility. Not only had soil quality degraded, but bugs were literally eating the nation's lunch, while plant diseases ravaged the leftovers. Such was the urgency for new, hardier crops that in 1825 President John Quincy Adams ordered US Consuls around the world "to forward rare plants and seeds to the State Department." The US Navy handled shipping, while the newly formed Patent Office (then under the jurisdiction of the State Department) coordinated distribution.

By the 1830s the federal government sponsored global botany expeditions (which, among other things, is how the soy bean came to the US in the early 1900s). To test the viability of the imports, the Patent Office built greenhouses and demonstration gardens, including a garden right across the street from the Capitol Building.

It took a Civil War, however, to create a cabinet-level Department of Agriculture. Most of the opposition to such a move had come from states that had seceded, so once they were conveniently out the way in 1862 President Lincoln seized the moment. That same year the first Homestead Act was enacted, which opened up millions of acres to new American farmers and the mass removal of indigenous tribes from their ancestral lands.

With the signing of a few documents, not only was there a new, massive need for seed, but also for basic farming know-how. To help with the latter, the Land-Grant College Act was introduced. Each state was given 30,000 acres per Congressional district that could be sold to finance the establishment of schools to teach the “agricultural and mechanical arts” (“A & M” schools).

USDA was now in charge of breeding and distributing seeds to farmers, taking over where the Patent Office left off and expanding efforts to make sure there would be enough varieties under cultivation (cultivars) to handle the many climates, soil types, pests and pathogens of a rapidly expanding nation.

By the early 20th century, USDA was in competition with an emerging commercial seed industry. Within a generation it was out of the seed business altogether.

PATENTS & DIVERSITY

The privatization of the seed industry – selling high-performance, genetically nearly identical hybrid seeds to farmers – had a profound impact on American agriculture and eventually on farming all over the world.

Since the very beginning of agriculture, farmers had always saved seed from each harvest to use for planting the following year. Modern hybrid seeds produced bigger harvests, but planting seeds from hybrid plants was a gamble. Recessive traits that could reduce yields or cause other problems often emerged in the next generation. Farmers now had to buy new seed each year, not only adding a cost, but also losing a measure of control over their livelihood. Seed sovereignty gave way to seed dependence.

USDA’s taxpayer-funded work to develop and distribute new cultivars had been considered a public good: a critical part of the nation’s infrastructure, like roads. Now the nation’s “seed roads” were turning into toll roads controlled by commercial seed companies focused on harvesting a profit.

During the 1940s, in the aftermath of WWII, stockpiles of chemicals that had been used for making bombs were adapted to make vast amounts of fertilizer, which further boosted yields, but added another cost. As fields of monoculture crops – soy, wheat, corn, barley – increased in size, they also became more vulnerable to pests and pathogens. That fueled demand for all sorts of new chemical solutions – pesticides, insecticides, herbicides and fungicides – each adding to the farmer’s cost of production. Ironically, these chemically-enhanced bumper crops meant low commodity prices, so farmers grew more, but at a greater cost and diminished profits.

Meanwhile, an increasingly complex stew of deadly petrochemicals that had been spread and sprayed across the land annihilated the soil microbiota critical to fertility. Decades of tillage not only shredded soil structure, but also sent massive amounts of soil carbon, a greenhouse gas, into the atmosphere. The degraded, deadened soil was less able to absorb water, leading to more runoff and reduced resilience to both flood and drought.

Vicious cycles set in: Less fertile soil increased the need for fertilizer. And as pests and pathogens developed resistance, more powerful chemicals were needed to keep them in check. To meet the challenge [seed companies began to merge with chemical companies to provide a one-stop-shop, selling everything a modern, industrial-scale, commodity farm now required.](#)

In the mid-1980s, the Supreme Court upheld a ruling that made it legal to patent genetically modified seeds. This also made it illegal for farmers to save *any* GMO seed. Twenty years later, in an opinion written by Justice Clarence Thomas (a former lawyer for seed-and-chemical giant Monsanto, now owned by Bayer), the Court ruled that the Patent Office could patent seeds because Congress hadn’t passed a law *specifically forbidding it*. Since then, thousands of hybrid and genetically modified plant varieties have been patented, including some specifically developed to work in tandem with proprietary pesticides.

The diversity of seeds for agricultural crops has diminished dramatically over the last century. Some believe that [more than 90% of the varieties for many fruits and vegetable have been lost](#). Others point to the success of the seed-saving movement that has managed to preserve and propagate hundreds of older cultivars. Yet with tens of millions of acres now planted fence row to fence row with patented, commodity crops, there is no question that there has been a tremendous a loss of seed diversity *representation*. The old varieties are vastly outnumbered.

“Genetic diversity is the hedge between us and global famine,” warns [Will Bonsall, a veteran seed saver from Maine and the founder of the Scatterseed Project](#). Breaking it down by category, [The Crop Trust](#) – which helps maintain the “Doomsday” seed bank in Svalbard, Norway – lists six key areas where seed diversity plays a critical role: ensuring food security, adapting to climate change, reducing environmental degradation, protecting nutritional security, reducing poverty and ensuring sustainable agriculture.

Seed diversity speaks to planetary stability. In North America, native ecosystems – forests, grasslands and wetlands – were cleared to make way for massive farm fields and sprawling cities in a matter of decades. Now in matter of minutes vast swaths of rainforest from Indonesia to Brazil are lost: an estimated 200,000 acres per year, an area roughly 14 times that of Manhattan, first stripped for valuable timber, then burned to the ground. Vast tracts of land once full of countless native plants that supported vibrant, interconnected communities of microbes, insects and animals (many seasonal or migratory), have been transformed in a blink into single-crop monocultures.

Seed diversity is the keystone of biodiversity. Its loss, the beginning of the end.

SEED SOVEREIGNTY

The rapid expansion of agriculture in the US came at a steep environmental cost. It is nearly unbelievable that prior to the Homestead Acts of the 1860s, tall grass prairie covered 170 million acres across the American Great Plains and Midwest. Today only 4% remains, and most of it is in Kansas.

There was also a devastating human cost. The millions of acres of North America (aka "Turtle Island") that were opened up by legal fiat to American farmers during the 19th century was land that been occupied for millennia by indigenous tribes. As these farmers staked their claims, Native tribes were forced off their land. Their crops were burned. Precious seeds were lost.

Seeds are the nexus between past and future. The hunt for those lost seeds, so integral to cultural identity, has become a quest to heal tribal communities and restore what was violently broken. The Indigenous Seed Keepers Network, an initiative of the Native American Food Sovereignty Alliance (NAFSA), works with regional and tribal seed saving groups to "rematriate" and share ancestral seeds.

Seed saving emerged as *cause célèbre* in the 1970s and '80s: a grassroots movement infused with hippie idealism to counter the corporate agendas and proprietary monopolies of Big Seed companies. It continues to be driven by passionate amateurs for whom sharing seeds with other growers is both a mission and a joy. "Ultimately life does not go on in an ark," says Will Bonsall, pointing to the limitations of seed banks. Most seeds need to be planted every few years to keep a viable supply.

It takes a village – a global village filled with gardeners and farmers – to keep the shared legacy of seeds alive.

For nearly forty years the Decorah, Iowa-based Seed Savers Exchange has been an important part of that global village. The Exchange began with a couple of jars of seeds. Today, the collection has

grown to 20,000 seed varieties and its free catalog, filled with photos of heirloom vegetables, old-timey flowers and seed origin stories, has become a must-read for home gardeners and organic farmers.

The seeds may be vintage, but the world in which they – and we – find ourselves is in the midst of existential change and colliding crises, amplified by an increasingly unstable climate.

Everything is different, including what it means to restore a natural ecosystem. [Near Chicago an experiment for restoring native landscapes for the future is just getting underway.](#) A farm field is being returned to its natural state – a prairie – but the region’s climate is expected to become hotter and drier over the next couple of decades, more like Oklahoma, less like Illinois. To figure out what will survive over the long haul, 60 acres will be planted with local seeds, while another 120 acres will be planted with the seeds sourced from as far away as Kentucky. Time will tell what thrives.

There is another, invisible variable in play. Plants are infused with microbes that provide all sorts of beneficial synergies: delivering nutrients, absorbing water, protecting against pests, fighting off pathogens. Plant microbiomes are intricately connected with those of the soil and air. Will seeds from elsewhere form the same kinds of microbial synergies as the natives? Will they bring something new, perhaps something better-adapted to a changed and changing world?

SEED COATS

The growing understanding of the role microbiomes play in plant health inspired a team at Boston-based biotech [Indigo Ag](#) to analyze the microbiomes of agricultural crops in the field. Specifically, they were interested in the microbiomes of corn and soy plants that managed to grow in areas where few plants were able to survive due to flood, drought or disease.

Since these plants were grown from hybrid, GMO seed, they were all nearly identical genetically. The scientists reasoned that something else provided the differentiating advantage. They took samples from plants and soils and used sensors to measure everything that could possibly be measured. Next, vast amounts of data were analyzed and vast numbers of microbes isolated and evaluated in the lab. Eventually specific microbes were identified that seemed to give the plants superpowers.

The scientists then coated seeds with these special microbes and planted them to see how they would compare against untreated, genetically nearly-identical seeds. Sure enough, yields improved. Microbe-coated seeds are now commercially available.

Coating seeds is not a new idea. Typically, it has meant spraying seeds with chemicals such as neonicotinoids to keep insect pests in check. Neonicotinoids have been linked to Colony Collapse Disorder in bees. (Often farmers are unaware of the specific chemicals used on their seeds.)

Microbial seeds coats are about growing plants strong enough to fend off pests on their own: working with nature rather than against with it.

On that extraordinary, long ago day, the first flower bloomed. Then something even more remarkable happened. The first flower made seeds for the second flower – the beginning of a chain of life that continues to this day.

Each seed embodies vast, invisible networks that link the microbial to the cosmic (light), and connect water, earth and sky. Each seed is a story about weather, climate, wind, tides, insects and animals. Each seed holds secrets about landscapes past and the promise of what could be.

Each seed is also a story about us, *homo sapiens*. Seeds have made our existence possible providing directly or through the plants they grow, food, shelter, medicine and clothing. Flowers feed our souls through scent and beauty.

Each seed is legacy and salvation.

Each seed is the future.

BIBLIOGRAPHY

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- * [native landscape seeds](#)
- [seed business](#)

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OVERVIEW

[Plant Evolution](#) | MOOC Botanique, 2015 | **video**

The first seeds date back 360 million years ago (in pine cones), but it would take another 220 million years for first flowering plants to bloom.

[The First Flower](#) | Nova, PBS, 2007 | **video**

Using fossils, electron microscopes and molecular analyses, scientists try to figure out when and where the first flowering plants began their global conquest.

LONGEVITY

[One of World's Longest-Running Experiments Is Buried in a Secret Location in Michigan](#) | Science Alert, 2016 | **article** Since 1879, 20 bottles of seeds buried on the grounds of the MSU campus have been tested periodically for viability.

[After 2,000 Years, These Seeds Have Finally Sprouted](#) | The Atlantic, 2020 | **article** Mazel tov! Several ancient date palm seeds gathered from archeological sites in Israel have sprouted.

[32,000-Year-Old Plant Brought Back to Life—Oldest Yet](#) | National Geographic, 2012 | **article** Spring springs eternal with high-tech assist.

SEED BANKS | RESEARCH ORGANIZATIONS

[The Crop Trust](#) | **website** Germany-based NGO focused on global crop biodiversity projects. Help administer the “Doomsday Vault” in Svalbard, Norway. Administers the Crop Diversity Endowment Fund. Sponsors annual Seed Summit.

[The Millennium Seed Bank Partnership, Royal Botanic Garden, Kew](#) | **website** A global collaboration for safeguarding wild plant diversity, particularly plants at risk of extinction.

[CGIAR: Consultative Group on International Agricultural Research](#) | **website** A France-based, global partnership of 15 independent, non-profit research organizations focused on securing a food secure future.

[FAO: Food and Agriculture Organization](#) | UN | **website** International organization focused on global food security, hunger and nutrition.

[Russia's Vavilov institute, guardian of world's lost plants](#) | [phys.org, 2017](#) | **article** Overview of the one of the world's largest, oldest and most important seed banks. During WWII's Siege of Leningrad, several staffers died of starvation defending it against Nazi takeover.

[National Germplasm Resources Laboratory](#) | USDA-ARS | **website**

[Germplasm Resources Information Network \(GRIN\)](#) | USDA | **website** Responsible for acquiring, characterizing, conserving and distributing germplasm important for food and agricultural production to scientists.

[Center for Plant Conservation](#) | San Diego Zoo Global | **website** A network of more than 60 conservation partners that collaboratively work to save the imperiled plants of the US and Canada.

[The CPC Rare Plant Academy](#) | **website** A terrific resource with videos, best practices and a networking platform.

[Seed Matters](#) | **website** Created by the Clif Bar Family Foundation to improve the viability and availability of organic seed to ensure healthy, nutritious and productive crops. Offers graduate fellowships classical plant breeding.

[National Association of Plant Breeders](#) | **website** US-based organization that brings together plant breeders working in federal, state, commercial and non-governmental organizations. NAPB hosts an annual conference and produces podcasts and webinars.

REPORTS | HISTORY

[150 Years of Research at the United States Department of Agriculture: Plant Introduction and Breeding](#) | USDA-ARS, 2013 | [pdf](#) A fascinating, history about the origins (in the Patent Office) and first several decades of USDA.

[Jefferson's Pursuit of Rice Seeds | Monticello](#) | [article](#)
Yes, Thomas Jefferson was also a smuggler.

[World's Plants and Fungi](#) | [website](#) Annual reports produced by the Royal Botanic Garden, Kew.

[Access to Seeds Index](#) | [website](#) Annual publication analyzing the efforts of the world's leading seed companies to enhance the productivity of smallholder farmers. Produced in conjunction with the [World Benchmarking Alliance](#), an independent research organization based in The Netherlands that focused on the UN's [17 Sustainable Development Goals \(SDGs\)](#)

[Seedquest Market Data](#) | [website](#) Links to agricultural reports from all over the world.

SEED SAVING RESOURCES

[Seed Savers Exchange](#) | [website](#) Since the 1970s, Seed Savers, based in Decorah, Iowa, has worked to preserve America's culturally diverse but endangered garden and food crop heritage through the collection, growth and sharing of heirloom seeds and plants. Request a catalog (free in the US)

[The Maine Farmer Saving the World's Rarest 20 Heirloom Seeds | DownEast, 2020](#) | [article](#) Interview with Will Bonsall, seed-saver extraordinaire and founder of [The Scatterseed Project](#).

[Seed: The Untold Story](#) | [documentary](#) | [website](#)

[Open Source Seed Initiative](#) | [website](#) OSSI works with plant breeders who commit to making one or more of their varieties available exclusively under the "copyleft" Pledge: *"You have the freedom to use these OSSI-Pledged seeds in any way you choose. In return, you pledge not to restrict others' use of these seeds or their derivatives by patents or other means, and to include this Pledge with any transfer of these seeds or their derivatives."*

[Rocky Mountain Seed Alliance](#) | **website** A nonprofit organization focused on sourcing local seeds for the Rocky Mountain region. Offers a variety of [Seed School](#) programs, including some online.

[Navdanya](#) | **website** From its origins as a seed-saving exchange in 1987, Navdanya now serves more than six million farm families in India through a network of 111 Community Seed Banks. Founded by food activist Dr. Vandana Shiva, Navdanya also offers training in organic growing practices. In 2011, [Navdanya International](#) was founded to take the “Seed Freedom” movement global.

[Saving Seeds with Vandana Shiva](#) | **video**

[Gardening is Important, But Seed Saving is Crucial](#) | **Civil Eats** | **article** Overview with many useful links.

[The Seed Saver: A Korean American Farmer Connects With Her Roots](#) | **video**

[Seed Broadcast](#) | **blog** This is a fascinating, slightly confounding series of websites all about seeds, with

a focus on the American Southwest. It is part art collaborative, part media, part resource. Much of the content is dated but still interesting.

[Southern Exposure Seed Exchange](#) | **website** Since the early 1980s Virginia-based SESE had been selling heritage, organic vegetable, flower, herb, grain and cover crop seeds with a focus on varieties particularly well-suited to the Mid-Atlantic and Southeast regions. In 2020, overwhelmed by demand, they added a page to their website promoting [a number of “tiny seed companies” all over the US.](#)

[27 Organizations Working to Conserve Seed Biodiversity](#) | **Food Tank** | **article**

[Community Seed Network](#) | **website** A fabulous resource that connects and supports dozens of community seed initiatives across the US and Canada. These include collections offered by public libraries. Find out what’s happening near you!

[The Search for Esiah's Seeds](#) | **Food Programme, BBC** | **podcast** The story of a passionate, if unlikely, seed saver, whose small garden in a poor section of London really did change the world for the better.

SEED SAVING BASICS

[How to Save and Use Seeds From Your Own Fruits and Vegetables | Peaceful Valley Farm & Garden Supply](#) | **video**

[Saving Garden Flower Seeds | Garden Answer](#) | **video**

[Saving Vegetable Seeds | University of Minnesota Extension](#) | **website** A good general overview.

[Seed to Seed | Suzanne Ashworth](#) | **book** A reference that includes techniques for saving 160 different vegetables along with botanical information and germination tips.

[Homegrown seed is the kernel of a food revolution | The Journal, 2020](#) | **article** An op-ed from an Irish newspaper highlights a key issue in the global food system: Where do the seeds come from? In Ireland, which is ranked second in the world for food security, *“95% of vegetable seed (is) imported and either grown or transported through Europe.”* Many countries don’t require country-of-origin labeling for seeds, making it that much harder to know exactly where seeds come from.

[The Seed Garden: The Art and Practice of Seed Saving | by Lee Buttala & Shanyn Siegel](#) | **book** A collaboration between Seed Savers Exchange and Organic Seed Alliance, features detailed instructions on how to save 75 different seed types.

NATIVE AMERICAN SEEDS

[NAFSA– Native American Food Sovereignty Alliance](#) | **website** Programs focused on the role of traditional food and agriculture in Native American culture, including the “rematriation” of seeds. NAFSA is the parent organization of the [Indigenous Seed Keepers Network](#).

[Centuries After Their Loss and Theft, Native American Seeds Are Reuniting With Their Tribes | Gastro Obscura, 2020](#) | **article** Seeds for crops important to Native American tribes thought to have been lost to history have been discovered in seed banks and museum collections. Now they are being propagated and “rematriated” with their tribes.

[Native Seeds Search](#) | **website** Based in Tucson, NSS focuses on arid-adapted seeds of the American Southwest with an emphasis on seed-saving and sharing among Native American tribes.

[Traditional Native American Farmers Association](#) | **website** Since 1992, TNAFA has marched to its own agronomic drum, rejecting large-scale, commodity agriculture in favor of “family oriented scale farming designed to build / rebuild local communities and restore health. ”

[The Origins of "Carl's Glass" Gems Rainbow Corn](#) | **Mother Earth News** | **video**

[This rare, vibrant heirloom corn is the work of a Dust Bowl farmer with Cherokee roots](#) | **Boing Boing, 2020** | **article** "Glass Gem" corn, which glows in a rainbow of colors, was developed through traditional seed-saving and breeding techniques. Its genetic dazzle emerged when older varieties of corn were bred back to match ancestral lineages used by Native Americans. "The seed remembers," noted Oklahoma farmer Charles "White Eagle" Barnes.

[A New Bill Could Help Protect the Sacred Seeds of Indigenous People](#) | **Civil Eats** | **article** In 2019 a bill was introduced in Congress with bipartisan support to direct the "Government Accountability Office to study the long-term viability of Native seeds and the programs and laws that could safeguard them."

NATIVE LANDSCAPE SEEDS

[Seeds of Success – SOS](#) | US Bureau of Land Management | **website** SOS collects wildland native seed for research, development, germplasm conservation, and ecosystem restoration.

[The Chicago Botanic Garden's Dixon National Tallgrass Prairie Seed Bank](#) | **website** A collection of 4,000 accessions representing 1,700 species, including some of the rarest species in the Upper Midwest.

[Seeds of change: Lake County forest preserve begins experimental restoration](#) | **Chicago Tribune, 2020** | **article** Habitat restoration must now take rapid climate change into account, which means finding plants best suited for future conditions.

[Indigenous Landscapes](#) | **website** Ohio-based native plant nursery and publishing house. Publisher of "*Native Plant Agriculture (Vol. 1)*".

SEED BUSINESS

[Mergers of “Big 6” Seed and Ag Chem Companies - Who Owns What Now](#) | AgFax, 2019 | **article** In 2015 six companies dominated the global seed and agricultural chemical market: BASF, Bayer, Dow Chemical, DuPont, Monsanto, and Syngenta. Since then Dow and DuPont have merged; Bayer bought Monsanto (with BASF buying some of the former’s massive seed portfolio to satisfy regulators); and [Syngenta merged with Chinese chemical giant Sinochem](#) | AFN, 2020 | **article**

[Arizona is in the corn business with opening of Bayer's high-tech greenhouse near Tucson](#) | AZ Central, 2020 | **article** To speed the breeding process for corn, Bayer is moving indoors, building a massive, automated, \$100,000 greenhouse.

[Maximizing seed value](#) | Bayer | **website** Company overview of its Seedgrowth® and Peridiam® seed coatings.

[Toxic Acres Study](#) | Friends of the Earth, 2019 | **webpage** Overview of a peer-reviewed study published in the journal PLOS ONE that found that since the 1990s US farmland has become 48x more toxic to insect life due to the widespread use of neonicotinoid pesticides. Seed coatings “account for approximately 80-90 percent of total neonicotinoid use in the US.

[Pesticide seed coatings are widespread but underreported](#) | Science Daily, 2020 | **article** Overview of a data analytics study by researchers at Penn State that shows a significant number of growers are unaware that seeds they used were coated with chemical insecticides and fungicides. They also found that data on seed treatments were inconsistent, leading to significant underreporting of usage.

[Never Out of Season: How Having the Food We Want When We Want It Threatens Our Food Supply and Our Future](#) | Rob Dunn | **book** Written by an evolutionary ecologist, this book takes a deep historical dive into how we have squandered the biodiverse bounty that was our planetary legacy; and how we can slow and possibly reverse the damage.

[Here's how 'five startups in one' Indigo Ag plans to use its \\$360m Series F add-on | AFN, 2020 | **article**](#)

[Geoffrey von Maltzahn of Indigo Ag Talks Plant Microbiomes and Decommoditizing Agriculture | MIT | **video**](#)

[An Introduction to the Big Business of Cannabis Seeds | Green Entrepreneur | **article**](#) The legalization of marijuana has led to race to patent seeds.

[Row 7 Seeds | **website**](#) Created by chef Dan Barber, plant breeder Michael Mazourek, and seedsman Matthew Goldfarb, Row 7 positions itself at that "anti-Big-Seed": a small company focused on delivering seeds for the tastiest fruits and vegetables possible, all organically grown and non-GMO.

[Chef Dan Barber on Row 7 Seeds and Changing Food Culture | **video**](#)

[Seed Stories from the Lockdown | The Food Programme, BBC | **podcast**](#)

[Grain by Grain: A Quest to Revive Ancient Wheat, Rural Jobs and Healthy Food | Bob Quinn | **book**](#)

Born into a farm family in Montana, Bob Quinn witnessed the damage of chemical-dependent agriculture first-hand. Over the last 30+ years as an organic farmer, he has overseen the restoration of the land and discovered the benefits –nutritional, environmental, economic–of non-GMO heritage wheat.

[Rebuilding Rural Economies with Ancient Grain and Regenerative Practices with Bob Quinn | Regenerative Agriculture | **podcast**](#)

[Wheat Revolutions | The Food Programme, BBC | **video**](#)

[Indigo Ag | **website**](#) This Boston-based Agtech company has raised over \$1 billion from investors since its founding in 2016. The company's first product was a line of seeds coated with beneficial microbes designed to increase yield. It has since expanded into several businesses, including a marketplace designed to "de-commodify agriculture."