



Small-Scale Organic Seed Production

Patrick Steiner





Acknowledgements

This booklet was made possible through funding from FarmFolk/CityFolk, the Organic Sector Development Program of the Certified Organic Associations of British Columbia, and Investment Agriculture Foundation. I'd also like to thank the farmers I interviewed, this handbook's strength lies in their experiences... Greta Kryger, Carolyn Herriot, Frank Morton, Maude Powell, Don Tipping, and Nash Huber. Special thanks to FarmFolk/CityFolk for support and encouragement to finish this manual, to Colleen O'Brien for editing, and Michael Marrapese for the design and layout.

About the Author:

Patrick Steiner is an organic farmer in Sorrento, British Columbia. He operates Stellar Seeds, a certified organic seed company specializing in rare and heritage vegetable varieties.

© FarmFolk/CityFolk Society.
All rights reserved.

ISBN# 978-0-9809387-1-7

Published by
FarmFolk/CityFolk Society.

Funding for this manual came from the Organic Sector Development Program.

This 40-page manual is available for \$10 in print format or \$5 as an electronic copy in pdf format. To get a copy of the manual, contact FarmFolk/CityFolk at admin@ffcf.bc.ca



Contents

Introduction	5
The Art of Seed Growing: Voices From the Field	7
Marketing Models	17
Seed Yields	23
Seed Storage	27
Seed Cleaning	31
Disease Prevention and Seed Treatments	35

Appendix

Resource List	40
-------------------------	----

Tables

Table 1: Seed Economics Matrix	22
Table 2: Seed Yields	25
Table 3: Seed Longevity in Ideal Storage	30
Table 4: Minimum Germination Standards for Canada No. 1 Seed	34
Table 5: Hot Water Seed Treatment Guidelines	38



Introduction

Organic seed production in British Columbia is not new. There exists today a host of small-scale organic seed companies and growers that have been producing and distributing seeds for some time. Their efforts have done much to provide BC citizens and farmers with a wide selection of biodiverse and rare varieties of vegetables, flowers, herbs and even grains. Without the many people committed to growing these seeds, many of these varieties would be much harder to access for BC growers, perhaps even impossible.

Today, a new challenge faces the BC organic farming community. The increase in consumer demand for locally grown organic produce leads to a greater demand for organic vegetable seeds. Our task is to take the commitment and passion that has driven our local, small-scale seed saving efforts and expand it, to enable the production of seeds on a scale that allows us to provide them in bulk quantities to our market farmers. As with any expansion or growth, new approaches and methodologies are needed to overcome challenges to increasing local seed production. This handbook seeks to provide information helpful in meeting that goal.

Producing seed locally in British Columbia presents many opportunities for farmers. As a tool for expanding biodiversity on our farms, seed production introduces new crops, cropping patterns and even beneficial insects or wildlife to the farm. For growers looking to diversify the economic outputs on their farm, it opens new possibilities for income generation, while reducing input costs through the production of seed for use within their own farm operations. Seed production also strengthens the resiliency of local food systems, ensuring that the basic starting point for all food production, the seed, is managed from within our communities.

.....

“Our task is to take the commitment and passion that has driven our local, small-scale seed saving efforts and expand it, to enable the production of seeds on a scale that allows us to provide them in bulk quantities to our market farmers.”

.....

There are those who claim that organic seed production needs will be met by the same large, multinational seed companies that produce the vast majority of the conventional seeds used by organic farmers today. Organic seed production however is not simply about producing seed free of synthetic chemicals, but also about producing seeds grown within the context of sustainable, local farming systems where farmers and consumers define how our food is produced.

In traditional farming societies seed has often been seen as a communal resource; by the same token it has also been a communal responsibility. This holds true for efforts to increase local seed production in BC today. It is impossible for any single producer or seed company to supply the needs of a diverse and healthy farming sector. A cooperative effort is required, with different regions, farmers and seed companies producing seeds and communicating amongst each other about strengths, challenges and the overall needs of BC's organic farming community.

This is not a "How To Grow Seeds" manual. Such information already exists and still more is being produced. A resource list at the end of this book details some readily accessible print and on-line

resources about the how-to of seedgrowing. Beyond the mechanics of growing and harvesting seeds however, there are other considerations for the farmer seeking to incorporate seedgrowing into their farming systems. The strength of this book lies in the first-hand experiences of a number of growers who have shared how seed growing has become a part of their farm economy and ecology. The insights they have gained, and the lessons learned are useful for any BC or Canadian farmer looking to grow seeds and contribute to the overall strength of a successful and sustainable local agriculture.



“In traditional farming societies seed has often been seen as a communal resource; by the same token it has also been a communal responsibility.”



The Art of Seed Growing: Voices From the Field

Why Grow Seed?



The growers featured in this handbook have all chosen to grow seeds on their farms. In every case, there was no single reason to grow seeds, but rather a variety of reasons including farm ecology, economics and personal interest. No grower began by trying to grow seeds before learning first how to grow crops. Indeed, most people would agree it is not possible to grow a good seed crop without first becoming proficient at the skills needed to raise a good market, or eating crop. It typically follows that for an engaged grower raising crops for consumption, there is a natural inclination to explore the later stages of a plant's lifecycle as they form flowers and set seed. Added to this natural curiosity are a host of other reasons for making seedgrowing a part of one's farm operation.

Frank Morton, an Oregon farmer raising mixed greens for the restaurant trade began noticing accidental crosses happening in his fields, which manifested as salad greens with novel traits. He quickly realized he could develop a line of his own salad greens that would look distinctive in the marketplace. He first started saving seeds simply for his own use, but with the popularity of his diverse and unique salad mixes a demand for the varieties he grew led him to making that seed available to others.

Farmers often grow their own seed in response to the rising cost of purchasing seed for their farm operations. Carolyn Herriot, a Vancouver Island grower, realized she could save seeds from her perennial plants to propagate seedlings in her nursery business, cutting considerable expense from her yearly seed purchases. Nash Huber, a Washington State grower says, "I save seeds for the economics of it. Seed is expensive, I use thousands of dollars of carrot seed in my operation."

Like many of the other growers in this handbook, Greta Kryger, an Ontario seedgrower, found herself saving certain seeds because varieties she relied upon were becoming unavailable, or she had problems getting certain seeds across borders. Likewise, Nash Huber gives this example, "I can't stress enough... we're particularly known for our carrot, and the carrot we're known for is not available commercially. It used to be, then became unavailable, and it so happened I had a stock of it. 'Well', I said, 'I better start growing it.' I also have a variety of cauliflower that I've used for 30 years. It's not my variety, but I've picked it up and maintained it, it's no longer available commercially and it's a great variety. It works very well for us, fits a growing window ideally, so is important. In the portfolio of seed I use, at least one variety disappears each year. So I save these



varieties because they fit into specific slots in my farm operation, so I'm not dependant on those varieties [to be supplied by someone else]."

Some farmers save seed so that they can improve on the lines that are available commercially, or adapt them to their specific farm ecologies. Frank Morton talks of having started with saving seed from varieties that he found weaknesses or flaws in, that he could then select against and end up with better seed. Today he is convinced that growing seeds for use on your own farm leads to superior plant growth, "Your own seed will quickly adapt to your farm micro-environment, giving you faster germinating, more vigorous plants. Within three seasons you will see a performance difference between your seed and the identical cultivar of commercial seed." And for Nash Huber, seedgrowing is like an insurance policy, "It gives me more control in the crops that I'm growing, in that I know I will have that seed, or adapt that seed. We plant several seeds in the range of carrots, cabbage, and spinach that we are selecting and breeding for our particular needs. We're selecting for what our customers look for, and also for our growing conditions and how we grow."

It's important to mention how many farmers grow seed for the enjoyment of it and the pleasure of learning more about agricultural diversity. Greta Kryger is fascinated by the diversity of heirloom tomatoes and squashes, Frank Morton by the brassicas, a crop group that he notes provides so many edible parts – roots, leaves, petioles, shoots, stalks, flowers and heads. This kind of diversity is the foundation of our organic agriculture, one of the most important traits that defines it from industrial agriculture. Farmers as seedgrowers are an integral part of maintaining that diversity. As Morton says, "all the different varieties that are needed by our farming community can only be grown with the heavy participation of many farmers. We need a million small

lots of varieties. We don't need big fields of a few things. The organic seed system people really want is an inherently dispersed kind of thing...I'm hoping."

Benefits for the Farm Ecology

When planned properly seedgrowing can also support or benefit other aspects of a farms' operations. Don Tipping, a farmer who grows seeds in southern Oregon says, "we're part of a cooperative CSA with five other farms which dovetails into all the seed work nicely because our culls and our rogues can go into the CSA or the farmers market. Or we'll just plant a little bit more of a seed crop so we can harvest some for market."

He continues, "seed growing works really well with our whole homestead system because the seeds [crops] are in the ground so much longer that we don't have to be as involved."

.....
"Diversity is the foundation of our organic agriculture, one of the most important traits that defines it from industrial agriculture."
.....

"Whereas with market gardening you're in there harvesting all the time and crops are in and out of the ground really fast, you have to pay more attention to that part of it. With the seed crops we get them planted, weeded, taken care of and then we work on other things, whether it's our perennials or picking raspberries or taking care of our animals or construction projects in the summer."

Seed crops can become part of a farm's planned rotation, helping with fertility or soil building. In the past Tipping grew half-acre blocks of peas and beans for seed. Though he didn't find these crops

yielded a great deal of money, they provided an ecological benefit as legumes in his rotation. Huber grows rye, vetch and barley, both as cover crop and for seed production. “Rye has gotten fairly expensive”, he says, “it’s easy to grow, and becomes part of our soil building program. We harvest the seed, and turn the straw back under, which rots over the winter.”

Frank Morton is perhaps the best known practitioner of seedgrowing as a method for introducing populations of beneficial insects into the farm or garden. He speaks about the incredible amount of flowering plants that a farm has during seed production, compared to regular vegetative production. These flowers are loaded with pollen and nectar, a critical food source for many predatory insects, and a large supply of this food means population booms that can then outcompete pests, which generally get their food sources through sucking or parasitism of the vegetative parts of plants. If he ever writes a book on this subject, it’ll be an instant farm-lit classic.

Inspiration, Mentors, and Ongoing Education

Most farmers have been inspired and educated by others in their profession. Seedgrowers are no different. Morton notes he was inspired by the work of Alan Kapular, a founder of Seeds of Change and well-known organic plant breeder, as well as by Rob Johnston of Johnny’s Seeds – it was Johnston’s little book on how to grow your own seed that was Frank’s first seed growing manual. Carolyn Herriot recounts meeting Dan Jason (of Salt Spring Seeds) while hitchhiking. She went to visit him at Salt Spring Centre, saw him amidst his seedcrops and has visited him each year since. He was her inspiration. Carolyn is basically self-taught as a seedgrower, but would ask questions of other growers at Seedy Saturdays, a popular event held across Canada to swap and sell seeds. These events she characterizes as a

“brilliant opportunity to ask questions, or share techniques, ie ‘I’m having trouble cleaning leek seeds. How do you do it?’ So I talked to other seedgrowers, and I would always go in field and visit Dan every year.” She continues, “Whenever there is a gathering [educational, on seeds] then I’m there because I know I’m going to learn something. When I’m around other seedgrowers I’m always bringing something back that makes my business or my seedgrowing practices stronger.” She also strongly recommends that would-be seedgrowers, “visit, volunteer or apprentice with skilled, experienced seedgrowers.”

.....

“Whenever there is a gathering [on seeds] I’m there because I know I’m going to learn something. I’m always bringing something back that makes my seedgrowing practices stronger.”

-Carolyn Herriot”

.....

Morton credits organic plant breeder John Navazio with formalizing his understanding of genetics in plants, especially the critical difference between crossers and selfers and open-pollinated population breeding. Morton has no other formal education in breeding and has learned mostly through doing many cycles of growing seeds, with each cycle learning more through observation; yet that little bit of formal instruction was key for him.

John Navazio has taught several multi-day workshops in British Columbia and shared his knowledge with our community of seed growing farmers. “Doing the workshop with John opened my eyes to the importance of selection,” Herriot says, “before, I’d always planted my rows, looked at it, ‘yes they all look healthy’, but I hadn’t taken the time to stop and inspect them side by side, one against

another. Now I have a new awareness of the importance of taking a close look at each plant." So now she is going back to many of her peppers and roguing hard to re-establish uniformity and true-to-typeness.

This kind of formal and informal learning from others is part of the territory for seed growers. Many growers have learned by doing, both on their own, or in the company of other, more experienced growers with whom they have worked. But when growing seeds, one is also working with genetics, and some amount of formal education is very helpful in understanding the processes that shape the seeds we work with. That's why partnerships between farmers and educators or scientists can be so fruitful.

Greta Kryger, of Greta's Organic Seeds in Ontario, speaks about her desire to access this kind of help from other experienced seedgrowers and scientists. Since not many opportunities exist in her area, she makes the effort to attend conferences and workshops in the Northeast U.S. This has led her to participate in farmer-led cucumber seed selection using knowledge she gained from workshops organized by the Restoring Our Seeds project. She learned to select for traits that affect plant uniformity and bitterness - tasting the leaf, once the first two true leaves are out. "If they're bitter, the fruit will be bitter. This is how to select before crossing happens, so that you can breed out bitterness," she says.

While Nash Huber did his first seedsaving for his own use, "without knowing much of anything", over time he began to learn more, and work with others. He now consults with John Navazio, and Lindsey duToit (a Washington State University seed pathologist). I asked him: "Is it necessary to have a plant breeder and a seed pathologist available to you as a farmer?" "It depends on how complicated you want to make it, how refined you want to get it," he replied "For a long

.....

"In order for BC grown seeds to meet with widespread support, growers need to produce the varieties farmers want, with consistent supply and consistent quality."

.....

time I didn't, but spinach diseases can last in the soil for quite a while, and we grow a lot of spinach, it's a commercial crop, we grow acres of it each year, you have to do a good job, and a lot of the diseases can be seedborne. Until we learned how to deal with it we were causing ourselves some trouble, so you need to know the basics, maybe not having access to hotshots like Lindsey and John, but that's the great thing about working with OSA, we have those resources to help us."

OSA is the Organic Seed Alliance, a non-profit organization based in Port Townsend, Washington. Through collaborative education and research programs with organic farmers and other seed professionals they work to help restore and develop seed varieties for the needs of organic farmers today. They have been holding a series of field days throughout the Pacific Northwest focused on delivering practical information to farmers on how to grow seeds and how to do it well. These field days are well worth the effort for BC growers to attend. OSA also works in a host of other capacities to support the development of networks of organic seed producers and seed companies capable of delivering the highest quality organic seed. Farmers can access a wealth of information, including constantly updated publications such as crop-specific seed production guides, at their website, www.seedalliance.org.

Quality Assurance

Even more than availability, perhaps the greatest barrier to farmers wholeheartedly switching to seeding their crops with organic seeds has been the issue of quality. Many commercial growers have been wary of abandoning their trusted seed varieties and sources and trying locally grown, organic seeds in their farm operations. Many organic certifying bodies now require or strongly recommend the use of organic seeds on organic farms, and with the growth in organic agriculture across the world, more seed varieties are being offered as certified organic. While some of this seed demand will be met by foreign seed suppliers there is an opportunity for BC and Canadian seed growers to become an important part of the seed supply for BC farmers. Concerns around genetic engineering and limits to the flow of seed across borders are other important factors favouring the strengthening of independent seed production and local seed security in BC. In order for BC grown seeds to meet with widespread support from the farming community, growers need to produce the appropriate varieties farmers want, with consistent supply and consistent quality.

This presents a dilemma for the BC seedgrowing community. While we have a number of experienced seed growers here, we need to engage many more farmers in the seedgrowing process if we want to meet the needs of our growers with locally grown seed. And we need to increase the size of our seed plantings in order to supply seeds in bulk amounts needed by market gardeners. As with any crop, there is a learning curve to growing seeds. It's inevitable that mistakes will be made and some problems of quality will occur. We're somewhat fortunate in that we can look at the practices of seed companies in the U.S. that have led the way in developing networks of organic seedgrowers. Over the past ten years companies like FedCo, Seeds of Change, and High Mowing have all had to deal with the question of seed

quality, and have developed practices to help ensure they are selling high quality seed. We can take the lessons they've learned and try to implement them early on in our efforts to increase local seed production.

Grower education is paramount in the effort to grow high quality seeds. Workshops and field visits are critical for farmers to learn best practices for seedgrowing, as are educational materials such as seed production guides, collaborations with agricultural professionals, and access to resources to help with harvest and post-harvest seed handling. Greta Kryger notes there are "new challenges for seedgrowers who target market gardeners, not just backyard gardeners." As both a seed producer and the owner of a seed company, Greta looks to buy seed from others to offer more

.....

"Strong partnerships between seed companies and local farmers are essential in developing a network of competent seedgrowers and production of high quality seed."

.....

diversity in her catalogue. While she would like to be able to offer seed from local growers, she has limited time and financial resources to visit potential growers in the field and determine their ability to grow good quality seeds. Given this, how does she know she can count on their seeds? Even for more financially prosperous seed companies this can be a quandary. Take the example of Seeds of Change, North America's largest organic seed company. They have a long list of farmers who would like to grow seeds for them, but even they can't just fly out to every farm that calls them up to look at their operation. One example of how to address these concerns is the quality

assurance program developed by the Siskiyou Sustainable Co-operative in Oregon. (see Ch. 2 Marketing Models for details).

Strong partnerships between seed companies and local farmers are essential in developing a network of competent seedgrowers and production of high quality seed. To do so requires supporting small, independent growers through educational initiatives like the ones mentioned above, backing them through the initial years when the learning curve is steepest, and realizing they will make mistakes when starting. This is particularly true in the case of working with open-pollinated cultivars where there may be less uniformity and the grower is relied upon to do in-field selection. If a seed company has not provided a well maintained stock seed, a farmer may find him or herself needing to rogue out a significant portion of the crop, and facing a reduction in seed yield. Morton asserts, "When something goes awry the grower should be able to call the seed company and openly communicate about it, and they will work with the grower to make it work. Not just cancel the project, but renegotiate price, and give the grower some parameters on where to go with the roguing, how heavy, etc. The company should not penalize the grower, because that would be a disincentive to proper management of the seedcrop. They should want the grower to do the right thing."

Economic Considerations

Producing seeds on the farm has economic benefits beyond strictly their cash value. Nash Huber notes, "the crops I grow for seed are multi-functional. I use the seed myself, and the other part of it is...I'll do it commercially - I'll sell some of it too." As mentioned earlier, seedcrops also benefit the farmscape biologically. Frank Morton points to a particular seedcrop, "I only grow 600 Sacred Basil plants, once every three years. But it's great in my rotation, and brings in

excellent predatory insects." The direct economic benefits of increased predacious insects may be hard to calculate, but few would deny they exist.

Still, when planting a crop specifically for seed production most farmers also want there to be a dollar value attached to the seed, something they can put in the bank at the end of the day. Which seedcrop will successfully deliver this is very farm-specific: it depends on your micro-climate, farm size, soil type, what crops you have experience growing, etc. Don Tipping says, "We really focus on the high value crops because we only have two and a half acres." Likewise, Huber notes that "I've come up with a number, on average, that I need to gross per acre on the farm in order to make enough money for all my costs and some profit. A lot of



"Find a variety that you like within each plant family. Then you can create a 'seed guild' of plants that are genetically diverse and won't cross with each other. Then you can sell to one seed company many different offerings."

-Frank Morton



seedcrops stay in the ground a long time, so they have to be higher value. Because you're tying your ground up for longer, you need to squeeze more money out of it."

While the dollar-value of a particular seed is obviously going to play a role in determining whether a seedcrop is viable on your farm, it may take some trial and error to figure out which seedcrops you can grow, harvest and process efficiently, which in my experience, often determines the financial viability of a seedcrop. Tipping relates that, "the ones that we've settled on, that we like doing, and have figured out a good system for are lettuce, tomatoes, onions and brassicas. Beet and



chard work out well for us, too. In the winter, when I have time, I calculate how much money a crop made per row-foot. That's a good filter through which we decide we're not going to grow things like beans or corn—we just don't have the land."

Frank Morton shares a little wisdom that he has gained in relation to seedgrowing economics, "I think you should find a variety that you like, within each plant family. Then you can create a 'seed guild' of plants that are genetically diverse and won't cross with each other. Then you can sell to one seed company many different offerings, something from each crop type. So you're not stuck selling only one mustard to a company, instead you can sell a mustard, a lettuce, a parsley, an amaranth, a squash, a tomato. That increases your sales per customer. Perhaps from a purely economical view, you would just specialize in one crop, like lettuce. Get all the equipment to grow, harvest and process the seed efficiently and become a specialty lettuce seed grower to maximize the efficiency of your seedgrowing. But it would skew the entire biology of your farm by forcing you to monocrop. So we don't want to get pigeonholed into doing the plants that are, a) easy, b) high in demand, or c) highest value. That is a formula for overspecialization and eventually a crash. It goes against the organic philosophy of mixing it up. So don't just grow the things that are easy and high value. Take into account that you can sell a lot more brassica and lettuce seed than tomato. Focus on the brassica and lettuce, but don't neglect the tomato. It can add value and diversity to your offerings to seed companies. It increases your sales to seed companies, who don't really need a lot of certain minor crops either, like quinoa or lovage. Some of these small things are really good for diversifying your farmscape. And remember, arugula was once a minor crop."

.....

"Farmer-led seed selection has been responsible for the development and steady improvement of all the worlds domesticated crop species."

.....

In the case of organic seedcrops, Morton also contends that economies-of-scale play a decisive role in seed prices. "The more you grow of something, the lower the price is going to be. It's one thing to grow an acre of something compared to a quarter acre. If you get down to a tenth of an acre you expect the price to go up still more. This is how I am when I talk to seed companies about contracts. They'll try to talk you down to the market level: 'Well, Frank, kale sells for \$10 per pound in the Harris Seed catalogue, you can't ask \$50 per pound.' If Harris was buying the same kale from me it wouldn't be \$10 per pound, because I'd be growing a small amount for them, and they would have to pay small lot prices. That's what you're paying for - small lot production. That's why prices are different, it's not because it's organic seed. They're high because they're being grown on a tenth of an acre. At this stage, we are asking for a custom product when we talk about organic seedgrowing. A seedcompany may try to get you to offer field-scale prices [read: conventional]. But until we grow on a field scale we can't do that." Companies may call Morton to set up a contract and ask how much he'll charge for seed. His first question is "How much do you want? If you want 1 pound it's \$100. If you want 100 pounds, it's \$60/pound. If you want \$1000 pounds, it's \$40/pound."

Selection Stories

Although today more and more hybrids are being produced organically, only a few years ago all organic seed production was of open-pollinated (OP) varieties. In grassroots, small-scale organic seed production communities across Canada

and the U.S., most seedgrowing continues to focus on OP seed production, and indeed many would argue this is paramount to retaining seed sovereignty and autonomy in the face of the continued concentration of seed production capacity locally and globally. Moreover, it is the rich diversity of open-pollinated varieties that form our agricultural legacy which provide all the necessary building blocks for developing plants capable of adapting to challenges in the environment, whether they come from climate change, pests or disease. Regional production, management and distribution, as well as commercial use of OP seeds is the best insurance that these varieties will be available to us when our local agricultural producers need them.

In the conventional seedgrowing industry, seed companies typically provide farmers with the initial seed which they want farmers to plant as a seedcrop. This seed, which has been grown and managed by the seed company, usually under the watchful eye of plant breeders and other seed specialists is referred to as “stock seed”. It is a known quantity, in that the seed company can be confident that the plants grown from this stock seed are of the highest quality, true-to-type and consistent in the various traits for which that line has been selected. Organic seedgrowers and seed companies in BC should also make every effort to develop stock seed for their growouts. This ensures a quality product that delivers greater uniformity and trueness-to-type, as well as maximizing the farmers efficiency by reducing the time spent roguing a poorly selected seedcrop, or at worst abandoning a project because of obvious crosses, disease problems, etc.

Because those of us growing organic seeds in BC are working with open-pollinated varieties, which are inherently malleable and changing in nature, it is important to monitor our seedcrops closely, selecting only the plants with a compliment of favourable characteristics for seed

production. Additionally, since many of the OP varieties available are considered to be of lesser economic value than hybrids, less work has been done by seed companies to maintain them well. This means that when we initially buy an OP seed for a growout to produce a seedcrop, we may find ourselves needing to do a heavy amount of roguing and selection to arrive at an acceptable set of plants for seed production.

This may seem like a lengthy and daunting task at first, but remember that once you have developed your stock seed, you will never have to do this initial “cleaning up” of a variety again. Also, as regional organic seed companies across North America have been increasing production capacity, and seedgrowers have been increasingly able to access resources to help them in their seedgrowing efforts, OP seed quality has improved. So you may already start with a high-quality seed lot. Another way to ensure you have the best possible seeds to start your seedgrowing with is to follow the advice of John Navazio. He insists the first step to any serious seed project is to take a look at the breadth of germplasm available for any one crop type or variety you have selected to grow seed for. By taking one year to do a growout of many lines of the same variety you can see the strengths or weaknesses of different lines and choose the one that most suits your needs. He claims doing this will save you years of work that you might spend cleaning up a line that has been poorly maintained.

The good news is that selection is not difficult to do. Farmer-led seed selection has been responsible for the development and steady improvement of all the worlds domesticated crop species. While the skills and knowledge-base around saving our own seeds have been less practiced by Canadian farmers in the 20th century, there are exciting opportunities to relearn this craft for growers who want to save seeds for on-farm use or for commercial

sale. I can say with confidence that there is no substitute for experience when it comes to making selection decisions. The more you grow seeds, and practice walking your fields with a critical eye, the better you become at selecting ideal seed producing plants, or just as often, selecting out the plants you don't want to produce seed.

Nash Huber describes where selection fits into his seed production process, "Selection is an ongoing thing. For carrot seed we have three varieties of our own, and every two or three years we'll grow each of those out. About every five or six years we'll do a selection on these varieties. We'll grow them out, pull the roots and select for type, appearance, flavour, for sweetness, and then we'll replant and take seed from those and that will be a stock seed batch. We'll use that to produce seed from for the next round in our production. We could go as much as five or six years before doing another selection. It all depends on how the roots look to us, whether we're seeing changes, whether we're happy with where we're at. Someone might say, 'we could change the tops on these a bit, maybe we could select for that...etc.' It takes a couple of times of selection to really shift the population towards the traits you've selected for. Particularly in an outcrosser like carrots, it takes two or three times at least, and we're not talking about big changes. We're also working with a cabbage and a kale that we're trying to do more radical changes with. You can do those things, it just takes time."

Through seedgrowing workshops in British Columbia, John Navazio has emphasized the importance of not selecting based on single-trait criteria. It is important to always be considering a number of traits when making selection decisions. For example, don't just select for shape, or for colour. Select for both, and ideally a number of other characteristics. Frank Morton describes a selection process he went through on a

lettuce variety, that illustrates this point well. In an effort to improve seed yield, Morton has been selecting for larger seedheads in his line of Outredgeous lettuce. But he hasn't been extreme by bagging one or two plants with large seedheads to then grow a whole population from. Instead, he has gone through and selected 20-30 plants out of 3000 plants, selecting for things like downy mildew resistance, overall plant vigor, and seedhead size. Because his selection criteria is not exclusive, this is why he only ends up with 30 ideal plants out of 3000. If he were to only select for large seedhead size there would be more available, but some would be prone to disease, etc. Morton does his selection all throughout the growing season, selecting at the seedling stage (for colour, vigour, etc.) and throughout the vegetative life cycle. He also makes selections when disease presents itself, and again as a mature seedbearing plant so that he can see how fast the downy mildew has spread, whether it's development was arrested or not, and look for other diseases such as erwinia, sclerotinia, and botrytis. He tags these plants with different coloured tape or ribbons to denote a selection for specific criteria. At the end, when all the different selections have been made, he keeps the plants that were selected most of the time. The 30 plants selected had a constellation of different positive attributes that ranged throughout their life cycle, from young plants to mature seedbearers. In the end, Morton thinks he will have an Outredgeous lettuce that is more vigorous, more disease resistant and better seed yielding than what he started with.

Saving seeds from one's best plants has been practiced for millenia; it works and it gives results. This method is called mass selection, and it is the foundation of most traditional seed-saving practices. Huber's carrots and Morton's lettuces are examples of crop management and improvement through mass selection.



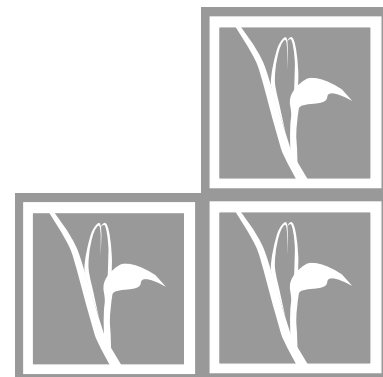
Don Tipping relates this story of cleaning up a seed line using mass selection to produce stock seed for a company. “Seeds of Change has been paying us to do some radish improvement work where we grow out 20,000 roots of a variety, pull them all up, then select down to the best 2000. You basically eliminate 90% of the population. There’s five or six criteria that we’re looking for: root colour, root shape, no really thick taproots or forked roots, and we’re also selecting against wire worm damage and also weak top attachments. It’s a totally different thing than a regular seed contract. They pay [a set fee] for the whole project - to grow the roots, do the selection and produce the seed, regardless of yield.

“So last year, the first year, we grew four varieties of radish. We did all the root selection on it. We grew one of the varieties at our farm and then the other three we had other growers do for isolation purposes. So we made [half the contract] on the selection and they made [half the contract] on the seed production part of it. Seeds of Change actually took the seed that was produced from this growout and sent it to southern California that fall to do a trial against the seed that was the initial planting stock before the selection, to evaluate how much improvement was made in one generation, and they noted massive improvement.”

In this case, part of the speed with which Tipping notes mass selection produced crop improvement is likely due to how heavy he rogued the crop, eliminating 90% of the undesirable roots. Growers practicing less radical selection pressure will also see crop improvement, it just may take more time. The important point is that the ability to improve crops rests in the hands of the grower. All three of the growers mentioned above have collaborated with educational institutions, seed companies and other seed professionals, underlying the importance of accessing off-farm resources in helping growers produce high quality seed crops.

Mass selection is not the only method farmers can use for seed selection. At one of our seedgrowing workshops in B.C. John Navazio outlined the principles of progeny testing, a method for seed selection that can be quicker and more effective than mass selection, though to do properly it requires a greater deal of organization.

Progeny testing involves using all the same criteria for selection that one would use in mass selection. Instead of harvesting all the seed and pooling it into one lot however, the grower isolates seed lots from each plant. If collecting seed from 100 plants, for example, you harvest the seed into 100 separate bags, each labeled with a number identifying the plant. The next season you plant 100 rows, each row sown from one of the bags. This method allows for easier visual identification of strong and weak traits from the 100 mother plants. By grouping the offspring from one mother plant in a single row, favourable or deleterious traits associated with a specific plant become more distinctly obvious. You can eliminate quickly and efficiently any problems by roguing the entire offspring from a certain mother plant - you’ve essentially isolated it and made it easier to select out. Among the rows of plants that you have left to grow, you can also rogue out individual plants that don’t meet the criteria you are selecting for. In this selection method, a grower can make quick progress in achieving a specific breeding goal.



Marketing Models



For many farmers, the greatest business challenge they face is not producing a crop, but marketing it. Selling seeds grown on contract to a seed company is the standard model for most conventional seedgrowers, a market being assured before the crop even goes in the ground. In small-scale organic seed production many Canadian growers direct-market their seed, through a number of different mechanisms. But in the US, where networks of farmers growing commercial organic seeds are more developed, contracts between farmers and seed companies are more and more common, and in fact, becoming the norm.

An example of a hybrid approach between direct marketing and contract selling is the model that Frank and Karen Morton have developed in their farm operation. Having started by direct-selling selections of unique varieties Frank had developed through his salad business, they created a catalogue in 1994 to put a face on the growing list of seeds they could offer, and to have something physical to show potential buyers. Frank claims a catalogue or list helps show others your understanding of what you have grown, “if you can write about it, it gives a buyer some confidence about your product, it’s one way to answer the question about how seed companies can trust your seed.” Frank recommends that anyone creating a list or catalogue like this should make efforts to get it to the right people, the owners and purchasers at seed companies.

Because seeds are not a common crop for farmers to grow and market, many farmers considering growing seeds have

no concept of how much a crop is worth, or what price they should ask for when trying to sell seeds. Seed pricing has several components to it, Frank says. “What is that seed worth on the market today? A company can’t offer you more than what they can sell it for. I look through all the catalogues and see what the market price for seeds is. If I’m going to approach a company, I study their prices closely before I ever talk to them. There is no sense in trying to bargain for something that is way out of whack for that catalogue. I also keep a running track record of prices I’ve sold seed for in the past, and use that as a guide.”

.....

“In planning what seed crops to grow, always take into consideration how much demand there is for a particular seed.”

.....

Frank also struck on a novel approach to marketing his seeds. He created the Wild Garden Seed Society, a project in which he offered his services as a seedgrower and farmer/breeder to 4 or 5 seed companies. They send him a yearly “subscription” (\$1500-\$2000), and then he sends them a sample of his breeding work every year. The advantage to the seed companies is that he sends them seeds he is developing, but not making available through his own seed catalogue, he calls this The Unlisted List. It is a way to funnel his work to the people who support it, and underwrite his breeding efforts. By getting the companies financially involved, by investing in his breeding work that they want to benefit from and buy, he has created both a patron to support his work and a buyer to buy his seeds.

This is a rather rare situation, because Frank is a self-taught breeder with a unique body of germplasm to offer, but it can certainly be an inspiration to other farmers about the value of innovating new varieties.

Seed Contracts

In planning what seed crops to grow, always take into consideration how much demand there is for a particular seed. For example, there is less call for tomato seeds, because relatively few seeds are needed. But root crops, salad greens, and other things that are grown in bulk, or as succession plantings require more quantity of seed, and market opportunities are greater. "It doesn't take a whole lot of pounds of seed of any one variety to fulfill all of our needs for a year," Morton cautions. "How many pounds of Lacinato kale seed get planted across North America in one year on organic farms?" he asks, "probably no more than a few hundred pounds per year. It doesn't take any great skill to flood the market for one particular variety. Then the price is so cheap no one wants to grow it anymore. This is where contracts are very helpful, it helps you know how much to grow, because you're working with a company who knows how much they're going to sell. As a grower you want to grow enough to meet that plus whatever else you think is going to come along, but you don't want to overdo it, or you'll just end up throwing it away. Contracts are completely the right way to go, there's no doubt about it."

When initially working with a seed company it's normal for contracts to be small. With time, and positive experience on both sides, opportunities will increase. Frank notes that last year he did \$11,000 in contracts for one particular seed company, that used to be only a few thousand. "You start out with someone and you're doing a certain amount and the more confidence they have in you by looking at your seed, the more they're going to contract with

you as they come into needing new things. They're going to suggest something that they need grown and they're going to give you the contract."

Are contracts necessary? Perhaps for the smaller scale of Canadian organic seed companies they may not be, but they can be a reassurance for both sides. Don Tipping speaks of an experience he had while growing seed on a strictly verbal agreement. "We were to grow 300 pounds of calendula. We had all the transplants and the greenhouse and were just about to plant it out and they called and said they wouldn't need any of it. So there we were, this was going to be four thousand dollars or something. For us that was a big deal. Plus we'd already grown out the transplants. We had no recourse on it. It really hurt our friendship because we'd become friends with the people that ran the company. Just the reassurance of a written contract is helpful, I think."

Contracts serve other purposes as well. Like defining the dates seed should be delivered to a seed company, in what condition, who will clean it, what amount of roguing/selection should be done and by whom. Expectations for things like germination rates or isolation distances can all be laid out in a contract and help growers know exactly what is expected of them. Contracts can also outline levels of support to the grower by the seed company, like whether a representative will visit the farm to help with things like selection or quality control, and on what dates. Is someone at the seed company available for consultation by phone throughout the growing season? Who is it? All this information can be clearly laid out in a contract, and helps both sides understand who is responsible for what.



Direct-Sales Marketing

Selling seeds directly to the end consumer is another approach, and the one practiced by most organic vegetable seedgrowers in Canada. Carolyn Herriot is an example of a Canadian grower who combines seedgrowing with another on-farm business. For many years she operated a nursery that brought in approximately 70% of her income. Most of that came within a short period during the busy spring gardening season.

Throughout the rest of the season she tended her plants, harvesting and later marketing their seeds through her seed company, Seeds of Victoria. The extra economic return she garnered from this made up the other 30% of her income.

Customers at her nursery always asked her for growing advice, so she decided to write a book, *A Year on the Garden Path*, detailing seasonal gardening tasks and giving tips for successful growing. It was a huge success and made her aware of the critical need for offering education about gardening and many other issues relating to food, health and environment. Carolyn now plans to devote half of her time to seed growing and the other half to the development of an educational centre.

When it comes to the cost of growing seeds, Carolyn points out that it doesn't cost much to grow seeds - she collects her seeds in brown paper bags, uses hairdryers and bowls, sieves and screens from around the house to clean them, and stores them in recycled plastic tubs. The biggest expenses come in marketing those seeds, she says. Printing seed packets is a big expense, as is a catalogue. Developing a website was an initial expense that she feels has paid for itself many times over. Almost 80% of her seed sales come through her website, and she will discontinue creating a print catalogue, moving to a strictly on-line catalogue. Additionally she sells seeds through about ten retail outlets in her area, and at Seedy Saturday events.

Similar in scale to Seeds of Victoria is Greta's Organic Gardens in Ontario, another regional organic seed company. Proprietor Greta Kryger uses many of the same marketing models as Herriot. Seedy Saturday events are a large part of her sales, and her website is another major source of revenue. Kryger hired a website promotion company to improve the ranking she receives on search engines, and noticed an immediate effect. Within the first six months sales doubled over the previous year.

For Kryger, advertising is one of the biggest expenses for marketing her seeds, but has found that advertising through

.....
"Maude Powell discovered that [seed] companies liked the idea of working with a group that had a coordinated marketing effort."
.....

the classified sections of regional and national farming/gardening magazines is affordable. She has explored the idea of doing retail sales through seed racks, but finds the cost of developing racks prohibitive. In cases where stores already have seed racks, she finds it economically feasible to work with them and create retail sales opportunities.

While many of her customers are backyard gardeners, Kryger also claims that there is strong support among Ontario and especially Quebec market gardeners for locally grown seeds, and she has many customers who are commercial growers. Some have expressed interest in buying bulk seed quantities from her, and because they are typically small-scale farms, may only need 100 or 200g of something. She says small-scale seedgrowers can easily meet those demands.

Marketing as a Co-operative: The Siskiyou Example

A common challenge small-scale seedgrowers face in marketing seeds to larger seed companies is the size differential between the company and the small farm operation. To pool resources and offer a more complete program to seed companies the Siskiyou Sustainable Co-operative (SSC), a group of growers in southern Oregon, has developed an effective marketing model that helps their members sell seeds to companies across the U.S.

Siskiyou member Don Tipping recognized the desirability of seed contracts as a way for farmers to diversify their incomes. As an established seedgrower himself he had spoken with one of North America's larger organic seed companies who said, "We have a whole stack of people that want to grow seeds for us, but how do we know if we can trust them? We don't know what quality seed they will produce." So growers at Siskiyou decided to develop a program for teaching members how to do it properly, and guarantee that growers were observing important things like isolation distances and paying attention to diseases or other quality issues. The cooperative became the intermediary between the grower and the seed companies, able to assure a high level of quality control was being observed.

Through conversations with several seed companies, SSC member Maude Powell discovered that the companies liked the idea of working with a group that had a coordinated marketing effort, where they would be able to communicate with one person representing numerous growers. Because the Siskiyou Cooperative members are mostly very small-scale, it saves the seed company the time and energy of dealing with a slew of small contracts with multiple growers.

Based on this, the Siskiyou Co-operative applied for grant money to develop a quality assurance program and marketing program.

The quality assurance program has five components, guaranteeing customers of the best quality seed possible.

1. All growers are certified organic
2. All seed is independently tested for germination rates by accredited seed labs
3. All seed is pathogen tested by the Oregon Department of Agriculture
4. A GIS pinning system is used to map seedcrops and ensure adequate isolation distances between farms/seedcrops. (This anticipates growth of co-op members, since currently the distances between member farms are large enough that pinning is irrelevant.)
5. Growers have access to technical assistance. (Grant money was secured to hire Don Tipping to be available for phone calls and email consultations to other growers. He was picked because he was the most experienced seedgrower in the area. Additionally, the Organic Seed Alliance would help train Don, and he could refer to them for any questions he may have.) Maude Powell notes that technical assistance is the most important component of the quality assurance program.

In the first year, the Siskiyou Co-operatives' marketing program would aim to sell seeds for 9 growers, and hired Powell as the marketing coordinator. She spoke with each grower, totaled the available acreage for seedgrowing, found out what they liked to grow and what they had experience at growing. By going to the EcoFarm conference and the Organic Seed Alliance conference she was able to meet industry representatives and approach them about seed contracts. She also cold-called seed companies, explained who she represented and found it

relatively easy to establish relationships and get seed contracts right away. In this case she was able to state that some of the growers had previous experience growing for Seeds of Change and FedCo Seeds. She could also point to the Co-operatives' Quality Assurance program. In this way they were able to land seed contracts with companies like Johnny's Seeds.

Powell negotiated contracts for many of the Siskiyou Co-op members. Seed companies found it simpler and advantageous to initially speak with one principal coordinator. The companies could later speak with individual growers throughout the season about concerns or issues for specific seed contracts.

Powell noted that the Co-operative can now get more contracts than they can actually accommodate, meaning there is lots of room for expansion for individual growers or for other growers to join. So why don't members grow more seeds then? She explains that most growers have a balance of seed and food crops growing on their farm, and are not necessarily looking to increase seed production. In her case, she feels she earns more money per acre through seed contracts than market production, but she values the social contact with her local community that she gets through marketing produce, which doesn't happen when growing seed contracts. Powell grows about a 70:30 ratio of produce to seeds, and is moving towards a 60:40 ratio.

While having a marketing co-ordinator requires payment on the part of Co-op members, Powell claims most have found it worthwhile. If a grower negotiates a contract on their own s/he gets the full sum of the contract. If Powell negotiates a contract on behalf of a grower she gets a

percentage of that contract sum.

"Particularly for new growers, a marketing coordinator can provide a bit more leverage with the seed company. It gives the grower more credibility because they are part of an established group with a good reputation. Other growers just prefer going through a marketing coordinator because it saves them the time and effort of marketing seeds themselves", she says.

Siskiyou Co-operative considered the idea of direct marketing it's own seed, essentially establishing themselves as a seed company outright. But through advice from others they have decided not to do so for the time being. The level of coordination involved in running a seed company, and the investment needing for everything from insurance, testing, overhead, capital expenditures and so on makes it quite difficult, Powell explains.

The time and expense involved in selling seeds is a challenge for all of the people profiled in this chapter, and different solutions to that challenge have been developed by all.

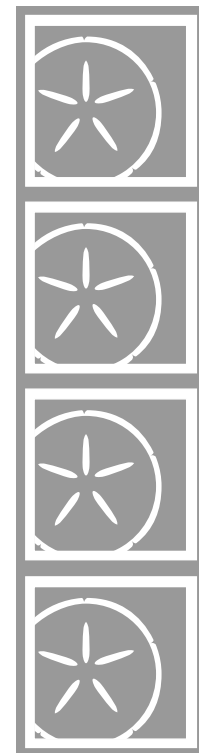


Table 1: Seed Economics Matrix

Seed Production Tracking			
Economic Analysis—Seed Production			
Inputs/Expenses:	Cost:		
Land			
Labor: management, planning hrs			
Labor: field hours			
Seed (planting stock) (wt. and est. value)			
Fertilizer/Soil Ammendments			
Pesticides			
Irrigation			
Certification Fees			
Equipment (rental or wear and tear cost est.)			
Other Indirect costs (depreciation, insurance, etc.)			
Total Expenses =			
Earnings:	lbs seed	value/lb	total value
Seed yield:			
Net Commercial Value:	\$		
total crop value			
total expenses			
NET EARNINGS			

Source: Organic Seed Alliance

Seed Yields



I am frequently asked how to best estimate seed yield and am at pains to explain that estimating seed yields is exactly that, estimating. And usually a very rough estimate is the most one can expect. As C.R. Lawn of Restoring Our Seeds points out, yields vary dramatically for many reasons, including “the skill of the grower and the fertility of her fields, the cultivar grown, crop spacing, and the weather that season. Because of this, there is almost no such thing as an expected yield.” Nevertheless, he agrees that rough guidelines for seed growers are helpful and worthwhile. Are rough guidelines available? The answer is yes, and no.

While researching seed yields, it quickly became apparent that there are not many sources for this information, and that many are either contradictory, or rely on old information. Where information is available it comes from the conventional seedgrowing industry, and data is given in yields per acre, something quite different than the scale that most Canadian organic seed growers are currently working in. As Frank Morton points out, “going from a one-acre yield estimate to a tenth-acre yield estimate, you now have more eyes-per-square-foot. In theory you should be able to take care of one-tenth of an acre better, and get a higher yield per plant than growing on a field scale. With greater care per plant you could easily double the yield. Of course, if you have too many one-tenth acre patches to take care of, that is a problem too.”

Even the organic seed growers I spoke with say that in most cases they can’t get good seed yield estimates from the companies who contract them to grow

“Yields vary dramatically for many reasons, including “the skill of the grower and the fertility of her fields, the cultivar grown, crop spacing, and the weather that season. Because of this, there is almost no such thing as an expected yield.”

- CR Lawn

seeds. These growers suggest the best thing to do is to call another farmer who has produced the seed crop you are planning to grow and ask them directly. If you are working with a seed company they should be able to give you contact information for farmers with previous experience growing specific crops.

Even in the case of receiving yield advice on a particular crop, bear in mind that yields vary widely from cultivar to cultivar within a crop type. Don Tipping relates an experience growing tomato seed on contract, “We were doing Roma for seed and also the Chadwick Cherry. We planted the same amount of each - 600 row feet. The Roma yielded seven pounds, we didn’t even make our ten pound contract. But on the cherry tomatoes we got twenty-four pounds!” C.R. Lawn also notes that cherry tomatoes tend to be more prolific than beefsteaks when it comes to seed yield.

This is important to the farmer because it affects the dollar value of the seed. Though Tipping was being paid \$300 per pound for both the Roma and cherry tomato seed, he argues, “the cherries should be paying me \$150/pound, and the Roma more like \$400/pound, because nobody’s ever going to want to grow it. I’m never going to want to grow Romas again.” He actually gave this feedback to

the company he was growing seed for, and they have begun to make changes that reflect the yield differentiation for different cultivars, but this is a slow process that takes a lot of communication and record-keeping on the part of both growers and seed companies.

Frank Morton has extensive experience with lettuce and brassica seedgrowing and has offered some general guidelines for yield. In general, he estimates that he will get 1oz. of seed from the average lettuce plant. He typically grows 600 lettuce plants in order to get 10 pounds of seed. (This refers to 600 transplants, not direct sown plants. It could be interpreted as 600 row feet of lettuce, or 600 plants that have at least a foot of growing space.) He says this figure assures him of 10 pounds of seed, even taking into account variables that can cause seed loss like disease, pests, bad weather, and roguing. On a good year, he might get 20 or 25 pounds of seed from these 600 plants, but he can always count on 10 pounds.

He feels these numbers also work for arugula and mustard, but cautions that it's not the same for all brassicas, which differ widely because of how many different crop types are in the brassica family. And he notes that cultural conditions affect seed yield too, "A direct-sown mustard crop in April will bolt earlier and yield less than a greenhouse-to-transplant mustard started in January. This brings up another variable that affects yield - the size of each

individual plant in your particular method of growing. Another variable is weed pressure. If you have a lot of weeds that haven't been managed you will surely have a drastically reduced seed yield."

Many growers and people at seed companies use Knott's Handbook for Vegetable Growers as a source for yield estimates. It should be noted that these are California yield statistics, and are likely going to be higher than Canadian yields.

In short, seed yields vary greatly due to many different factors. Growers wanting to maximize seed yield can do several things to ensure the best possible yield:

- ensure good soil fertility
- irrigate adequately, while considering the negative effects of certain irrigation practices like overhead watering, which may cause disease and lower seed yield.
- control pest outbreaks quickly
- keep seedcrops free of weed competition.
- use proactive practices that maintain optimal plant health.

With the disclaimer that seed yield is highly variable, I have nevertheless compiled a rough guideline of estimated yields. Growers should use these only as a very general guideline, the best information a grower can have for yield estimates is to keep detailed records of the seedcrops they grow and note all factors, ecological, cultural, climatic, and others, that may have affected yield. A good set of records will be the best aid for any farmer in estimating seed yields.

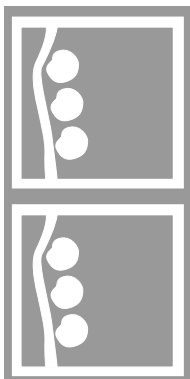


Table 2: Seed Yields

Crop	Cultivar	Amount planted	Yield
Bean	Average Bush Bean	840rft	63#
	Shirofumi Edemame Soybean	1600rft	190#
	Generic Bush or Soy	1# planted	10#
	Generic Pole	.5-1# planted	20#
	Broad Windsor Fava	200rft	27#
Beets	Detroit Dark Red Conventional	1 acre	1328#
Broccoli	Generic (ideal conditions)	10plants	1#
Brussels Sprouts	Generic	1 acre	300-600#
Burdock	Generic	100-200rft	9#
Cantaloupe	small, seedy varieties	100 plants	1#
Carrot	Long Orange Improved	930rft	12#
	Generic Conventional	1 acre	650-850#
Cucumber	Boothby's Blonde	1 acre	322#
	Generic Pickling Conventional	1 acre	1117#
Eggplant	Rosa Bianca	50 plants	1#
Greens	Arugula	1750rft	40#
	Cress, Broadleaf	750rft	19#
	Kale	1 plant	.68oz
	Mizuna	1200rft	64# (.85oz/plant)
	Mustard	40 plants	1#
	Mustard, Giant Red	1600rft	52#
	Mustard, Southern Curled Conventional	1 acre	1700#
	Tatsoi	1500rft	25#
Kohlrabi	Generic	1 acre	800-1300#
Leeks	Conventional	1 acre	300-500#
	Durabel	180rft	3.5#
Lettuce	Generic average	1400rft	18#
	Generic	1g	1#
Oats	Terra	1#	30#
Onions	Rossa di Milano (poor yield year)	700rft	6.6#
	Early Yellow Globe Conventional	1 acre	375#
	Southport White Globe Conventional	1 acre	486#

Crop	Cultivar	Amount planted	Yield
Peas	Generic average	600rft	40#
	Generic	1#	20#
Peppers	Generic	188 plants	1# (.085oz./plant)
	Sweet Chocolate	145 plants	1.5# (.16oz./plant)
	Generic small, hot	75 fruits	1oz.
	Nardello	600 rft	5#
	Ancho	720 rft	13#
Pumpkin	Long Pie	1 acre	513#
Radish	Misato Rose	420 plants (630rft)	7.5#
	Rat Tail	67 plants	4.4# (1.05oz./plant)
	Pink Beauty	400rft	3.75#
	Generic Conventional	1 acre	854#
Spinach	Bloomsdale Savoy	250rft	13.5#
	Bloomsdale Conventional	1 acre	1097#
Squash	Blue Hubbard Conventional	1 acre	633#
	Table Queen Conventional	1 acre	810#
Tomatoes	Generic	982 plants	15.4# (approximately .2-.3oz. per plant, but can vary from .1-.5oz./plant)
	Generic	100 plants	1#
	Generic	100# fruit	4-10oz. Average 100g for 15plants = 6.5g/plant
Turnip	Shogone Conventional	1 acre	1500#
Watermelon	Generic, small, seedy	30 melons	1#
Flowers	Calendula	1 plant	1oz.
	Marigold, French	132rft	.9#
	Morning Glory	30 plants	4oz.
Herbs	Basil, Lemon	150 plants	1#
	Cilantro, Santo	178rft	7#

Legend: All figures for organic crops unless noted as Conventional

rft = row feet

= pound

g = metric gram

Sources: composite from Steiner, Lawn, Kavanya, Tipping, Knott's

Seed Storage



Good seed storage is the best way to protect the time and money a grower has invested in their seed crop. Poor storage can lead to reduced seed

quality through rapid loss of germination ability, decrease in longevity of seed, and exposure to antagonistic pathogens.

Seeds are living organisms that require specific conditions in order to remain capable of producing healthy, vigorous plants. The general rule-of-thumb for seed storage is cool, dry and dark. This chapter will expand on this rule and give the farmer specific information helpful in maintaining highest seed quality for short and longer term storage.

Seeds are hygroscopic, meaning that they are able to both pick up moisture from the air and release moisture into the air. In air-tight storage of small volumes of seed, seed moisture content will influence the relative humidity of the receptacle in which they are stored. In bulk storage, or in containers that are not airtight the relative humidity of the room will determine the seed moisture content.

Most seed companies that purchase seed from farmers will have adequate storage facilities to keep seed in good condition. Farmers who grow seed and sell their entire lot to a seed company will have little worry about seed storage specifics since the seed company will be doing most of that. For growers who plan to store their seed crops an understanding of storage requirements is essential to maintaining optimal quality of seeds and protecting the growers time and money invested in growing the crop.

Influence of Temperature and Moisture on Seed

Good storage can easily be accomplished on-farm for minimal costs.

When storing seeds keep them consistently cool and dry. Excessive temperature and moisture, or even fluctuations in temperature and moisture, are the primary factors that lead to seed quality deterioration. Once seeds have been dried down for storage they are in a state of dormancy. Technically still “alive”, the seeds’ metabolic process has slowed, allowing the seed to sparingly use the energy reserves it has. In dormancy seeds continue to respire; taking in oxygen and giving off carbon dioxide. The key to maintaining high seed quality is minimal disruption of this natural dormancy. To do so means maintaining consistent cool temperatures and low humidity levels.

Temperature fluctuation is one of the worst things for seed storage, as this increases seed respiration rate, and depletes energy reserves quickly. Moisture also increases respiration rate and can contribute to the growth of micro-organisms and fungi that can attack the seed and render it less viable. Most seed

.....
“Seeds are living organisms that require specific conditions in order to remain capable of producing healthy, vigorous plants.”
.....

storage fungi are inhibited when relative humidity is below 65%. High temperatures will also increase respiration rate, and the combination of high temperatures and moisture can be enough to trigger growth in the seed. The importance of maintaining low storage temperatures is illustrated by the rule that for each 5.6°C (42°F) decrease in temperature, seed longevity doubles.

For longer term seed storage (greater than 18 months) many farmers put their seeds into the deep freeze, typically storing it in a chest freezer on-farm. Freezing seeds in this manner can result in excellent germination results years beyond the limits of “cool” storage outlined below (see Table 3). Nevertheless there are some dangers growers should know about before freezing their seeds. It is absolutely essential that seeds be well dried before freezing. Improperly dried seeds may lose their ability to germinate once frozen. This is because residual water, upon freezing, can expand and burst cell walls within the seed, effectively rendering them sterile.

An excellent on-line resource for detailed information on seed storage is Seed Processing and Storage: Principles and Practices by Jeff McCormack available at www.savingourseed.org

For storage of seeds less than 18 months, storing seeds at 2-10C (35-50F) with relative humidity of 30-40% is ideal. A quick guide which growers can use to determine a suitable location on their farms is to use a thermometer and hygrometer to determine temperature and relative humidity (RH). The following formula will let you know if your storage location is appropriate for good quality seed storage:

$$\text{Temp (F)} + \text{RH} < 100$$

The further below 100 the better. Avoid storing seeds in temperatures over 50F, even if RH is very low. McCormack’s on-

line resource mentioned above details the effects on seed viability of different temperatures and moisture readings.

A hygrometer is an instrument that measures relative humidity in air. This device is commonly available at most hardware stores and relatively inexpensive (approximately \$30). Growers can choose between mechanical or digital hygrometers, each having different advantages. Mechanical hygrometers are a little less expensive, but the needle may “stick” if the humidity does not change for a long time. Digital hygrometers cost a little more and are accurate in the mid to high humidity ranges but can be less accurate when RH is below 30%. Digital hygrometers often have built in digital thermometers which reduces the need for two separate devices to determine a good storage location.

Drying and Storage Tips

Knowing these temperature and humidity parameters should enable farmers to find suitable seed storage space on their farms. In the event that no space provides the climate needed, or the climate is unstable, one can modify a room to provide the right environment. Good insulation is an excellent buffer to outside temperature and humidity fluctuations. Access to electricity gives even more capacity to modify the storage environment. I have seen walk-in coolers, or even trailers outfitted with air conditioners used to effectively control temperature for seed storage. Extraction fans or dehumidifiers can be added if reduced air moisture is desired.

If seeds have been thoroughly dried and the storage environment meets ideal conditions, then airtight containers work well for storing seeds. However, because it can be difficult for the farmer to determine exact seed moisture content, or because storage spaces may have unstable environments, a safe method for storing seeds is in paper bags and envelopes,

which are then placed into larger air-tight containers like sealable buckets or tote bins. This method allows for some moisture exchange within the storage bin, meaning that seed moisture can be released into the inner environment of the bin. This guards against remnant seed moisture spoiling a seed lot that is stored in a small air-tight, moisture-proof space, such as a glass jar. Essentially the larger storage bin acts as a buffer between remnant moisture in the seed and air humidity outside the storage bin.

How does one determine when seed has been thoroughly dried and is ready for storage? There are commercially available portable moisture meters that can be bought which will give accurate seed moisture readings. The Harvest Hand moisture meter is one example, and more can be found through Internet searches. But most growers can determine that seed is dry enough for storage by the process of simply allowing seed to dry down in a room or barn where air humidity is minimal. Spreading seeds out on tarps, Remay, plates, baskets, or hanging in pillowcases, jute sacks or other breathable materials during the dry, warm days of summer or fall is enough to dry most seeds. Large seeds can be

physically tested quite easily. For example cucurbit seeds should snap, not bend, when folded. Large seeds like peas and beans should not be able to be dented by your teeth, or should crack or split between your teeth, not squish down.

Smaller seeds are more difficult to determine in this way, but adequate time in a dry environment will ensure you of sufficiently dry seed. Frank Morton, who grows a lot of brassica and lettuce seed described one of his methods for testing seed dryness at a recent field day. He buries a paper bag or envelope in a pile of seeds as a way to monitor seed moisture levels. After a few days he checks the bag/envelope. If it feels damp, or doesn't make a crumpling sound when he squishes it he knows the seed is still too moist and needs further drying. If the bag feels dry or makes crumpling noises when squished he knows the seed is dry enough to put into airtight storage. In storage he also keeps a paper envelope with harvest/variety records in the seed at all times for seed identification and as a handy moisture indicator. Bringing seeds into a house, or an environment with low, ambient heat will also help dry seeds fully.

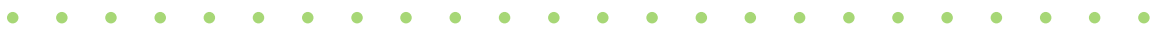
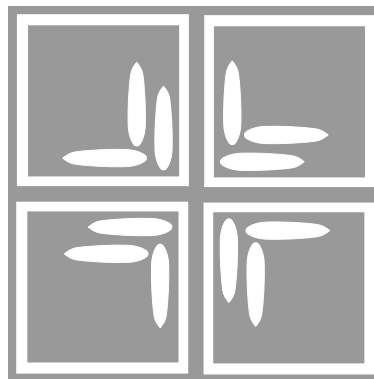


Table 3: Longevity of Seeds in Ideal Storage

Crop	Seed Life Span (years)	Crop	Seed Life Span (years)
Beans, bush and pole	3-4	Lettuce	3-4
Beans, fava	5-6	Mache/Corn Salad	5
Beets	4-5	Mustard	4-5
Broccoli	4-5	New Zealand Spinach	3-4
Brussel Sprouts	4-5	Okra	2-4
Cabbage	4-5	Onions	2
Cantaloupe	6-8	Parsley	3
Carrots	3-4	Parsnips	1-2
Cauliflower	4-5	Peas	3-5
Celeriac	4	Peppers	2-4
Chard	4-5	Pumpkins	3-6
Chervil	3	Radish	4-5
Chicory	4	Rutabaga	4-5
Collards	4-5	Salsify	2-3
Corn	4-5	Scorzonera	2-3
Cress	5	Sorrel	4
Cucumbers	6	Spinach	3-4
Dandelion	2	Squash	4-6
Eggplants	4-5	Tomato	4-7
Endive	4-6	Turnip	4-6
Fennel	4	Watermelon	4-6
Kale	4-5		
Kohlrabi	4-5	Sources: composite from H.G.Maine, McCormack/Knott's, Abundant Life Seed Foundation	
Leeks	2		

Seed Cleaning



A good rule of thumb to all successful seedgrowing is to start small, then expand as one gains experience and tools to make larger scale seed growing feasible. By

starting small one can learn through first-hand experience what parts of the seed growing process are most challenging, without the situation being overwhelming in either time or expense. This is particularly true of seed cleaning, which may require specialized tools or techniques.

Threshing and cleaning seeds can seem difficult and time consuming to the farmer who has little or no experience with this activity. For many people I have spoken to it is the most daunting aspect of seed growing. I have been told by many that they would be happy to plant a half acre into squash for seed, but the challenge of cleaning it makes it an unpalatable proposition. However, seed cleaning need not be a difficult task for the farmer. There are simple and inexpensive methods, some manual and others mechanical, for cleaning fairly large quantities of seed.

The first question a farmer asks when seed cleaning is whether the best way to clean seeds is by hand or by machinery. The answer usually depends on the scale of your seed crop. For farmers doing small seed lots the majority of seedcleaning can be done by hand. Machinery becomes useful when a seed lot is larger, or sometimes, during the final process of the seed cleaning when fine dust or small or broken seeds are being separated from the good quality seeds in the lot. In many cases, even this can be achieved through hand cleaning.

Most of the Canadian seed growers I know

have amassed a collection of useful screens, strainers, colanders, bowls, buckets, tarps, and fans to aid them in their seed cleaning, and almost all do it manually. Others have purchased dedicated seed cleaning screens from suppliers and mounted them on wooden frames. Some have purchased used seed cleaners and fanning mills that come with a variety of screens (with holes of different sizes and shapes) and may either use the machine for cleaning seeds, or simply make use of the variety of screens to manually clean their seeds.

Used equipment exists, but may take some searching to find. If found, it can be incredibly useful to small-scale growers. The American Pacific Northwest is an area where lots of used seed cleaning equipment can be found, something BC growers may find useful. Nash Huber cleans his cauliflower seed with a Crippen 143A that he bought used. It allows him



“Seed cleaning need not be a difficult task for the farmer.

There are simple and inexpensive methods, some manual and others mechanical, for cleaning fairly large quantities of seed.”



to get two or three different grades of seed from his harvest. But he also does a lot of hand cleaning for smaller lots of seed, and he notes that he enjoys threshing and winnowing by hand.

I currently do all my seed cleaning by hand, with the aid of screens I have rescued from an old fanning mill and the use of many tarps and buckets. A tremendous amount of dry-seeded



vegetable crops can be threshed by simply laying them on tarps and either beating them with sticks or flails, dancing on them with one's feet, or driving over them with a truck or tractor—and all these methods are commonly used by small seed farmers across the world. Once threshed the seeds and chaff can be quickly separated through the use of screens or by winnowing in front of a fan or a steady breeze. A little experimentation on one's farm is enough to establish which methods work best in any particular circumstance. It may seem that these methods are time-consuming but many would be surprised at the volumes of seed that can be cleaned this way. Hundreds of pounds of legume seeds can be cleaned in less than a day this way. Dozens of pounds of brassica seeds, and so on. It may not be as quick as if done by machine, but this method requires very little capital expenditure. Start simple, once a farmer has increased the volume of seed he or she grows, that is the time to consider mechanical cleaning.

Nevertheless, seed cleaning machinery presents certain indisputable advantages in the right scenario. For example, the Siskiyou Co-operative decided it would be worthwhile to get equipment because it would make the seed cleaning task easier and less labour intensive for growers. When the Co-op talked about expanding seed capacity the most limiting factor was the difficulty of cleaning large amounts of seed. Quality was also considered a limiting factor, and mechanical cleaning was seen as a way to increase quality and to ease the burden of manually cleaning larger amounts of seed.

The machinery allows for faster cleaning of seed. It also gives seed companies more confidence in the ability of the growers to deliver a high quality product. Having seed cleaning equipment at the Siskiyou co-op has led to seed companies giving them bigger contracts. Maude Powell notes this year's germination tests have come back with very high rates and seed companies have been very pleased with the quality of seed. She attributes some of

this to the use of a Clipper Eclipse seed cleaner they have recently started using.

The Co-op was able to use grant money as a way to acquire seed cleaning equipment and they have chosen to house it in a decentralized way, stored at three different farms. For members, there is a \$100 initial fee to join the equipment Co-op, and they charge growers \$20/day to use equipment. This fund goes to machinery maintenance and purchase of new machinery.

The Co-op utilizes two Alice-Chalmers All-Crop combine harvesters (with a third kept for parts) with which they can clean most of their dry-seeded crops. Due to the size of the machinery a minimum of 10 pounds of seed is needed for the machinery to be viable. The Clipper is then used to do most of the fine or final cleaning. Members come and use the equipment to clean their own seed, calling ahead and booking time to use the machine. Each member who houses the equipment is also paid to train the other growers on how to use the machine.

Powell and Tipping outline some of the disadvantages to using the machinery. Cleaning the machinery between seedlots is essential to avoid co-mingling of seed lots, yet it is incredibly time-consuming, so much so that when Tipping compares the mechanical cleaning to the hand cleaning he notes, "some of the hand methods we've figured out are pretty fast." And there is always the worry about seeds stuck in small corners of the machinery that will then contaminate the next seed lot.

There is a learning curve involved to effectively using seed cleaning machinery, and in the beginning growers can lose seed, or damage it. Tipping relates his first experience using the All-Crop to clean radish seed. "We had this big contract, 100 pounds for Seeds of Change. We'd done 20 pounds of radish before, but never this much. It was twelve Toyota pickups completely full of pods, and we were constantly evolving our techniques. When we were pulling up the plants we started by clipping the roots and bottom

stalk from the seedheads. Then we started joking, 'This is Oregon, everything should be done with a chainsaw!', so I went and got my chainsaw and we packed it up like firewood, with the pods all on the same end. I just sawed off the lower half of the plant, and it worked really well. I was surprised, we'd really been kind of joking. But compared to clipping all that by hand, you can imagine, it would have taken forever.

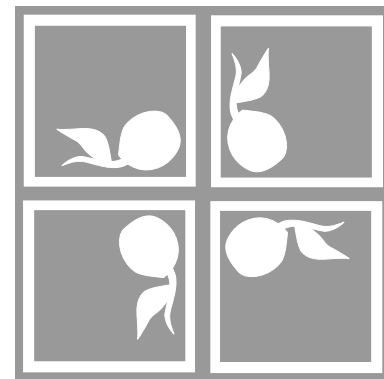
"After that we ran it through the All-Crop, but we were cracking a lot of seed. We had [a technician] from Bejo Seeds help us set it up to exactly the tolerances and settings they would use for radish seed, and we still cracked a quarter of the seed. It was so frustrating, I had over 100 pounds, but I'll probably wind up with 70 pounds of actual seed. I realized the machinery sometimes means you just have to grow more and plan on losses. And when you have a sixth of an acre of something really high value you can't afford to lose any of it, much less a quarter of it."

Still, Tipping has found the All-Crop really useful for certain crops, he calls it "the ideal onion and leek seed cleaning machine." He notes that there are more appropriate machines for radish seeds, like a belt thresher, which probably wouldn't result in as much seed loss. But that requires more investment, which is the trade-off. "For small lots, or especially wet seeds, we just do things by hand," he says.* "Tomatoes, for example: it's a lot of picking, but we put them in five-gallon buckets, let them sit for a week, and then squash them. We have a Douglas Fir pole with a T-handle on the top, we smash the tomatoes in the bucket, put them in a barrel, and we can do a lot of seed that way. It really doesn't take long."

In regard to tools and techniques for seedcleaning I have found that methods that work for one crop are often effective for all other crops in that plant family. For example, the screens and techniques I use to clean one type of brassica seed usually work for most other brassica seed, perhaps with minor modifications. The same rule

applies for legume seeds, cucurbits or solanums, etc. Once you have figured out how to clean one kind of crop, you can assume the ability to clean many other crops in that plant family.

Frank Morton echoes this by mentioning that he enjoys growing dry seed, not wet seed. He has developed techniques and amassed the tools and equipment to help with cleaning dry seeds. If he were doing wet seeds he would have to be handling water, hoses, sprayers and using different screens, barrel-washers, etc.—in short, a whole different set of equipment. Morton suggests a natural dividing line for seedgrowers is to work with one or the other, dry or wet seeds. And a good way to choose is to consider your climate. If you live in a wetter, humid climate (the east, typically) you may find wet seeds are more appropriate for you, while western growers (typically a drier climate) may find dry seeds better.



* Wet seedcrops are crops whose seeds are encased in a fleshy or fruiting part of the plant, such as the cucurbits and solanums. They typically require the use of water in the seed separation/cleaning process. Dry seedcrops produce their seeds in pods, umbels or spikes, such as the legumes, brassicas, composites, mints, etc. They do not require any water in the seed-cleaning process.



**Table 4:
Minimum Germination Standards for Canada No. 1 Seed**

Crop	Germination %	Crop	Germination %
Artichoke	75	Endive	65
Asparagus	75	Kale	80
Bean, broad	85	Kohlrabi	80
Bean, garden	85	Leek	65
Bean, lima	85	Lettuce	70
Bean, runner	85	Mustard (Brassica juncea)	80
Bean, soy	85	Mustard (Brassica rapa)	80
Beet	75	Okra	55
Broccoli	80	Onion	75
Brussels Sprouts	80	Parsley	75
Cabbage	80	Parsnip	60
Cabbage, Chinese	80	Pea	85
Cantaloupe/Muskmelon	80	Pepper	65
Cardoon	55	Pumpkin	80
Carrot	60	Radish	80
Cauliflower	80	Rhubarb	65
Celeriac	60	Rutabaga	80
Celery	55	Salsify	75
Chard	75	Sage	50
Chervil	75	Savory	50
Chicory	65	Spinach	65
Chives	65	Squash	80
Collards	80	Thyme	50
Corn, pop	85	Tomato	75
Corn, sweet	85	Turnip	80
Cornsalad/Mache	75	Watermelon	80
Cress, garden	75		
Cress, water	35		
Cucumber	80		
Dandelion, cultivated	55		
Dill	50		
Eggplant	65		

Source: Canada Seeds Act

Disease Prevention and Seed Treatments



Seed-borne diseases are of great concern to both the producer and the purchaser of organic seeds. An understanding of how to prevent diseases

in the field is critical in the effort to produce the highest quality, disease-free seed. Seed-borne diseases can lower germination rates, reduce seed storage viability, decrease seedling vigour or in cases where environmental conditions are right even cause widespread disease outbreaks in the field, leading to crop loss.

When talking about seed-borne diseases it is easy for the organic farmer to get overwhelmed by the sheer magnitude of diseases that can affect seed crops, therefore I think it important to always keep in mind that most of the time when we grow seed we are successful in producing disease-free seed. Many of the management practices already employed by farmers to produce healthy crops and maintain healthy soils are the fundamentals required to produce healthy, vigorous, disease-free seed.

After eight years of personal experience growing seeds I have only once harvested seed that presented obvious disease possibilities. The seed discolouration was so noticeable that I sent a sample away for diagnostic testing and upon confirmation of disease, destroyed the seed. Even before testing I knew trouble was brewing as the year had seen tremendous amounts of unseasonal rainfall, exactly the kind of environment that can spoil an exposed seedcrop drying down in the field. I have certainly left seedcrops unharvested for this exact reason, knowing full well that

inclement weather has produced favourable disease conditions on certain crops, but as part of a diversified farm operation these losses were not so tremendous as to be unsustainable.

Once diseases are established on a seedcrop, the tools available to organic farmers or seed companies for eradicating these diseases are minimal. The best approach is for farmers to use proactive farming practices that will minimize or eliminate seed-borne disease in the first place. This means practicing good crop rotation, creating disease-suppressive soil/compost, growing specific plants that act as habitats for beneficial predators, and testing soil to make sure it has proper amounts of trace elements, which are critical for plants to withstand disease pressure. Farmers should also observe



“Timely seed harvest once seeds mature is important in order to eliminate possibilities of disease invasion on seeds.”



appropriate planting dates where soil moisture and temperature allow for quick seed germination and plant emergence, reducing risk of exposure to diseases. If possible, seedgrowers can start with disease resistant varieties, and as organic seed growing expands, the in-situ selection of seed within organic management systems will naturally result in varieties with greater disease resistance. Likewise, one should remove diseased plant matter from the field or individual plants to limit disease spread.



Plant rows parallel with prevailing winds to funnel air movement that can suppress fungal growth. Wider row spacing also increases air flow. Timely seed harvest once seeds mature is also important in order to eliminate possibilities of disease invasion on seeds. The longer one leaves mature seed standing in a field, exposed to weather fluctuations and pest attack or traffic, the more opportunities disease organisms have to establish themselves. When it comes to harvesting mature seed, my experience (learned the hard way) is to not put off until tomorrow what you can do today. Likewise, the sooner a farmer can clean the seed he or she has harvested the better, thus separating seeds from chaff and other organic matter that may host disease organisms.

It's also important to reduce weed pressure around seedcrops, as many common weeds can be alternate hosts to parasites and diseases that can then attack one's

.....
“Farmers growing seed crops will do well to monitor their crops closely and to familiarize themselves with the identification of diseases in-field.”
.....

seedcrop. Reducing “green bridges” can also help in producing disease-free seed as pests like aphids can be vectors for certain diseases. Green bridges are alternate host plants that can allow disease or insects to travel between different areas of a field (knowing the alternate host plants for diseases can help us reduce incidence of disease, ie: over 15 common weeds are hosts to powdery or downy mildew, which can then spread to our crops).

How do you know if your seed is diseased? A common-sense approach will go far in telling you whether the seed you have grown is diseased. Following many of the management guidelines described above will ensure healthy seed. If a grower

observes significant pest or weed pressure in their seedcrop it is more likely that disease can establish itself on seed. Likewise, inclement weather at the wrong time is the farmer's worst enemy when it comes to disease. A significant bout of rain and humid weather at the precise time a crop is mature and drying down can easily lead to disease. Seed discoloration that is visible to the naked eye is a warning for the farmer to think seriously about getting a pathogen test done, or informing the buyer of that seed about disease possibilities. Germination tests that return low results of such seeds can also be an indicator of disease.

Farmers growing seed crops will do well to monitor their crops closely and to familiarize themselves with the identification of diseases in-field. There are good resources available to aid in this. The book *Diseases and Pests of Vegetable Crops in Canada* is a useful tool, with detailed descriptions of common plant diseases and excellent photos to help growers identify problems. The book costs \$65 and can be ordered by mail. A printable order form can be found at www.esc-sec.org/disease.htm. As a farmer, I have found the book excellent for identifying diseases in the vegetative stages of plants, though there is a distinct lack of information regarding diseases on the seedbearing parts of plants. Nevertheless the book is a worthwhile tool for identifying early problems in a seedcrop.

Another tool seedgrowers can use are diagnostic laboratories where leaf, tissue, or seed samples can be sent for disease identification, or even for official germination tests. In general it is hard to find labs that do much work with vegetable seed as it is considered such a minor crop. The closest labs BC growers can use for seed tests are in Alberta. 20/20 Seed Labs (www.2020seedlabs.ca) can perform germination tests on a wide variety of vegetable seeds, as well as pathology

tests on some vegetable seeds, though it is more costly. It should be noted that farmers can easily do germination tests in their own homes at no expense.

The Organic Seed Alliance website (www.seedalliance.org) has recently posted an excellent summary of plant diseases affecting spinach crops which was written by Lindsey duToit, a seed pathologist at Washington State University. OSA also has a paper outlining weather-related risk reduction strategies for farmers growing seedcrops. These, and other helpful information for seedgrowers, including production guidelines for specific seedcrops, can be found at the OSA website by clicking on the "Publications" tab on the home-page.

Preventing the onset of disease in a seedcrop is always the farmer's first goal. Nevertheless, because of the complex nature of the farm environment, diseases do occur. The presence of disease on a seedcrop does not automatically mean the crop is worthless. Both in-field and after harvest, there are a number of methods for controlling or eradicating disease in seeds.

Since the vast majority of post-disease seed treatments developed by the conventional seed industry are not acceptable in organic management systems, research into methods of organic disease eradication is ongoing. At the 4th Biennial Organic Seed Conference held by the Organic Seed Alliance in 2006 the most effective treatment currently proscribed is hot water treatment. The materials needed to do this treatment are easily available to the farmer or small-scale seed company, which is one of the great benefits of this

method. Also, experiments have shown this method to have widespread application for many vegetable seeds, though notable exceptions are the cucurbit species, peas, beans, sweet corn, beets and some other crops whose seeds can be damaged by hot water treatment or for which it is not practical.

This method involves carefully timed immersion of seeds in a hot water bath; the heat kills most disease-causing bacteria found on the seed coat as well as within the seed. Exact observation of recommended temperatures and immersion times is critical to successfully killing diseases with hot water treatment. Too little time or too low of a temperature can result in ineffective disease eradication; too much time or too high of a temperature can harm the seed and negatively affect its ability to germinate. Hot water treatment of seed should only be used for seed that will be planted in the same calendar year. This is because hot water treatment can lower the storage life of seed. It is also recommended that a small test batch of the seed be treated first and then tested for germination rate before treating an entire seed lot. Hot water treatment of old or poor quality seed will result in serious damage to the seed and low germination results.

Step-by-step instructions on how to do hot water treatment of seeds, including photos of each step can be found at www.ohioline.osu.edu/hyg-fact/3000/3085.html. A list of crop seeds and the temperatures and times recommended for hot water treatment follows.

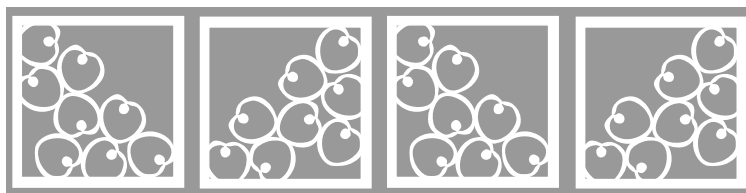


Table 5: Hot Water Seed Treatment Guidelines

Crop	Temp (°F)	Minutes	Disease Controlled
Brussels sprouts, cabbage, spinach	122	25	Alternaria, blackleg, black rot
Tomato	122	25	Bacterial canker, Bacterial spot, bacterial speck
Tomato	132	30	Anthracnose
Eggplant	122	30	Phomopsis blight, anthracnose
Broccoli, cauliflower, carrot, collard, kale, kohlrabi, rutabaga, turnip	122	20	Alternaria, blackleg, black rot
Mustard, cress, and radish	122	15	
Pepper	125	30	Bacterial spot, rhizoctonia
Lettuce, celery and celeriac	118	30	early blight, late blight

Source: composite from Ohio State University’s “Hot Water and Chlorine Treatment of Vegetable Seeds” Factsheet HYG-3085-05 and Knotts Handbook for Vegetable Growers - Hot Water Treatment of Seeds, p.315.

Other approaches to seed treatment include in-field applications to plants to reduce disease-causing fungi and bacteria that can establish on the seed. Biological seed treatments control seed pests by parasitizing the pest organisms, out-competing them for food on the root system, or producing toxic compounds that inhibit pathogen growth. Control of surface pathogens include beneficial microbes in compost teas, herbal sprays, washes and oils.

One biological agent that many BC growers have readily available to them that is proving effective in seed disease control is garlic extract - which has shown excellent abilities to suppress seed borne diseases without affecting germination rates of the treated seed. Source: www.sac.ac.uk/cropsci/external/orgserv/orgpublications/juanmsc.asp. It should be

noted that this test was done in relation to Fusarium on barley, and the garlic extract has not yet been shown to be effective on other diseases or on vegetable seeds.

Research into non-synthetic, biological compounds for seed treatment continues. At Wageningen University in the Netherlands tests using thyme oil and ascorbic acid have given promising initial results in decreasing seed borne diseases. Research in other countries around the world into biological control agents for seed born disease is progressing and many positive findings are emerging. The interested reader can find a lengthy list of print and web resources at <http://www.growseed.org/seedtreatments.html>.

Conclusion

The ability for BC farmers to play a role in determining local seed security and seed sovereignty rests in our hands. There exists a good base of seed growers and an even wider base of farmers with some experience growing seeds for their own use. Broad-based cooperation between farmers and other professionals will be required to meet new challenges for farmers producing seed, whether it be post-harvest seed handling, marketing, or other issues. Most important of all is to expand educational initiatives for farmers, including workshops, field days and mentorship programs in relation to seed growing. By building on the mentorships and educational initiatives now under way, and engaging more farmers in the seed growing process, we can expand the capacity of BC growers to supply ourselves with the quantity and quality of seed our market farmers need in order to make BC's organic agriculture truly sustainable and successful.

.....

“Most important of all is to expand educational initiatives for farmers, including workshops, field days and mentorship programs.”

.....



Print and Online Resources for Seed Growing

Books

Seed to Seed, Suzanne Ashworth, 1991, ISBN 0-9613977-7-2

How to Grow your Own Vegetable Seed, Seeds of Diversity Canada

The Seed Savers Handbook, Jude and Michel Fanton, 1993, ISBN 0-646-10226-5

Back Garden Seed Saving: Keeping our Vegetable Heritage Alive. Sue Strickland, 2001. ISBN 978-1899233090

Vegetable Seed Production, Raymond A.T. George, 1999

Seed Production: Principles and Practices, Miller McDonald and L. Copeland, 1997

Breed Your Own Vegetable Varieties, Carol Deppe, 1993, ISBN 0-316-18104-8

Diseases and Pests of Vegetable Crops in Canada, Ed. Howard, Ronald, 1994, ISBN 0-9691627-3-1

Principles of Plant Breeding. 2nd Ed. R.W. Allard, 1999.

Knott's Handbook for Vegetable Growers, 5th Edition, Donald Maynard, 2006, ISBN: 978-0-471-73828-2

Online Resources

The following crop-specific seed production manuals are available at www.seedalliance.org/index.php?page=Publications

1. "Principles and Practices of Organic Bean Seed Production in the Pacific Northwest"
2. "Principles and Practices of Organic Radish Seed Production in the Pacific Northwest"
3. "Principles and Practices of Organic Spinach Seed Production in the Pacific Northwest"



Copies of this manual are available for \$10 in print or \$5 in pdf format. Contact FarmFolk/CityFolk at admin@ffcf.bc.ca

The following organic seed production manuals are available at www.savingourseeds.org/growguides.html

1. "Isolation Distances"
2. "Seed Processing and Storage"
3. "Bean Seed Production"
4. "Brassica Seed Production"
5. "Cucurbit Seed Production"
6. "Pepper Seed Production"
7. "Tomato Seed Production"

Other Helpful Information on Seeds

Information and interviews on growing, marketing and breeding organic seed can be found at www.growseed.org/realseed.html

"The Wisdom of Plant Heritage: Organic Seed Production and Saving", published by NOFA, Bryan Connolly with C.R. Lawn, 2005. 99 pp. \$9.50, can be ordered at www.nofany.org/publications.html

"Diseases in Vegetable Seed Crops: Identification, Biology and Management - Part 1, 2, 3" found at www.seedalliance.org/index.php?page=Publications

"Spinach Diseases: Field Identification, Implications, and Management Practices" found at www.seedalliance.org/index.php?page=Publications

"Weather-related Risk Reduction Guidelines", found at www.seedalliance.org/index.php?page=Publications

"2006 Organic Seed Alliance Conference Proceedings" found at www.seedalliance.org/index.php?page=Publications

"Hot Water and Chlorine Treatment of Vegetable Seeds to Eradicate Bacterial Plant Pathogens", found at www.ohioline.osu.edu/hyg-fact/3000/3085.html

"The Cutting Edge" (e-newsletter from Seeds of Change with information on seeds), found at www.seedsofchange.com/cutting_edge/default.asp

"The Seed Bin" (e-newsletter from High Mowing Seeds with information on seeds), found at www.highmowingseeds.com