

# SEEDS

## Foundation of Growers' Success



Every year seed companies release new, improved seed varieties. Whether you're a backyard gardener looking for an organically grown heirloom variety or a commercial grower looking for a top-producing variety, you'll be amazed at the selection you find when next you shop for seed

By **Lynette Morgan, Ph.D.**

**B**ack in the day, small home gardeners and hobby growers had a limited selection of varieties available in small pack sizes from the local garden store, and many chose to collect their own seeds from their favorite plants. But things have changed for the better. Even the smallest hobby hydroponic gardener can buy top-quality hybrid seed similar

to those used in commercial production and take advantage of the years of complex plant breeding that goes into developing these modern cultivars.

At the same time, many commercial hydroponic growers and family farms can take advantage of the mass production of many of the older heirloom vegetable seeds that are becoming increasingly popular with growers large and small.



*Top left:* Many seeds store their food reserves for initial growth in the cotyledons, or seedling leaves, such as in this germinating bean seed. *Above left:* Good quality seed is vital for the success of many hydroponic crops. *Above right:* Seeds come in a diversity of sizes, shapes and colors. The bean seeds on the far left have been treated with a fungicide powder. *Right:* Seed viability testing can be carried out by anyone and is a quick way to determine if a stored seed lot will still germinate successfully.



Left: The range and types of seed available now in pack sizes to suit even the smallest hydroponic grower is extensive and worth taking advantage of. Top: Lettuce seed can have specific requirements for germination, with some varieties benefiting from light during the germination process. Above: Some species have seeds which germinate incredibly rapidly, within 24 hours in the case of these hydroponic basil seeds. Below: The first signs of germination in a seed viability test can usually be seen within 24-72 hours, depending on the species being tested.



## Latest Trends

Most seed companies are putting out extensive color catalogs, often several times a year, with the upcoming season's new releases. This, coupled with detailed online websites and ordering, means hydroponic growers aren't limited to buying seeds from the local garden store. In fact, the highlight of the growing season for many hydroponic growers is the arrival of a glossy new seed catalog. Often growers purchase seed online or via mail order from seed companies in search of that perfect variety or new fruit, flower or vegetable.

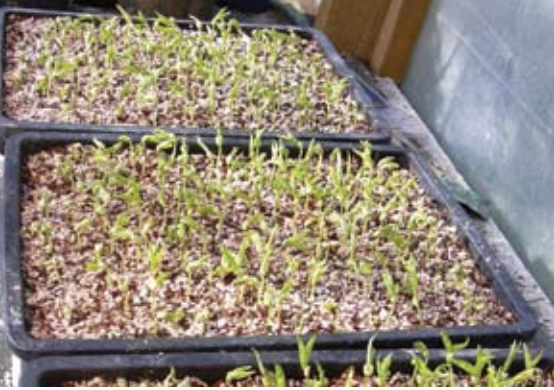
Trialing new varieties and seed selections is a good choice for both commercial and hobby hydroponic growers, and there are a number of reasons for doing

this. Plant breeders are continually trying to improve the characteristics of crops, and as hydroponic gardeners we can all take advantage of that. Disease resistance, hardiness, tolerance to hot and/or cold conditions, better fruit set, faster or more reliable germination, plants that are more compact for smaller spaces, improved yields and vitamin content, better shelf life and many other characteristics are continually worked on, especially with our favorite hydroponic plants such as tomatoes, peppers and lettuce.

All these improvements are great developments for commercial growers and have led to some major advantages, particularly increased disease resistance. By breeding in disease resistance, growers have many fewer hassles with pathogens.

In the past, growers were more likely to suffer plant losses and lower yields, or they had to do a great deal of spraying to achieve disease control in a commercial crop.

Good examples of this are tomatoes, where varieties can be chosen with multiple disease resistance to some quite serious pathogens which can occur in hydroponically grown plants, such as fusarium wilt, verticillium wilt, blight and others. Hydroponic basil growers can now choose to grow a fusarium wilt-resistant variety (Nufar F1). Lettuce seed varieties have also undergone extensive changes, with the range of improved fancy lettuce types increasing all the time. Many hydroponic gardeners are taking full advantage of the new range and exciting color variations.



Above, top to bottom: One of the main objectives in propagation from seed is uniformity of germination and seedling development. Pelletting of lettuce seed is a great advantage for hydroponic producers who often sow this higher-value seed into individual cells for easy of handling and transplanting. Some small or irregular shaped seed is pelleted for ease of handling and to also improve or assist germination. Lettuce seed is one such example. Below, left to right: High-quality greenhouse hybrid cucumber seeds can be expensive, so good viability and uniformity of germination is important. Old seed which has aged may still germinate, but often seedling vigor is reduced. Commercial seed packets usually contain important details such as the germination rate and purity.



According to seed companies, indoor and hydroponic gardeners and those growing in limited spaces in containers have a preference for compact varieties and also those with more disease resistance. Many growers, both commercial and hobby, also prefer pelleted seed for those difficult to handle seeds which might be irregularly shaped or small but are often direct-sown, lettuce and carrot being the main examples. Many hobby growers, like gardeners in general, tend to select seed types based on flavor, ability to perform well in a particular region and ease of growing. Also, they often have a preference for heirloom types.

Another increasing trend noted by seed companies is the rapid increase in container gardening. While most container gardeners are still not strictly hydroponic, they are largely soilless and make use of various potting soils, composts and soilless media with fertilizer incorporated. Smaller houses with little or no back yard space and the escalating interest in having colorful plants and fresh fruit, herbs and vegetables year-round has seen this market grow rapidly. Seed companies are now offering selections specifically designed for the container gardeners that are productive, compact and disease-resistant, all of which make great choices for small hydroponic systems as well.

### Seeds

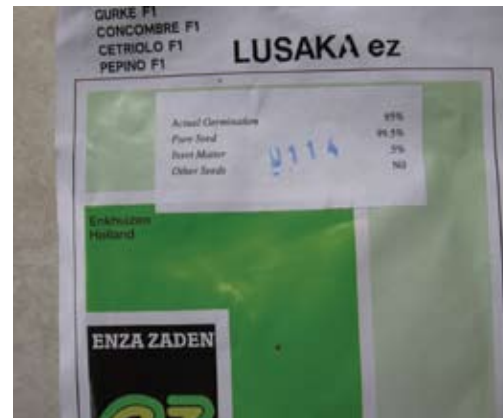
Commonly grown hydroponic crop seed varies considerably with regards to shelf life. Some species can only be stored for a few months before they start to rapidly lose viability. Others can be stored for years, even decades, and will still germinate successfully. Most of the commercially

grown vegetable and flower seed can be considered medium-lived—that is, they can easily store for 2-3 years or longer, provided they are kept under the correct conditions. Examples of seeds that are long lived are many weed seeds which can survive in the soil for many years (70 years or more in many cases) and Indian lotus, seeds of which remained viable for over 1,000 years and germinated perfectly when the hard seed coats were cracked. The rate of germination also differs between plant species. Lettuce may only take 24 hours under optimal condition before germination occurs. Other plants can take many days or even months before any sign of development can be seen.

### Types of Seed and Seed Production

Seed production for horticulture and agriculture is a large and important business. Plant breeders and seed producers have high quality standards, procedures and processes that ensure top-quality seed is grown, ripened, cleaned, treated and packaged in such a way that viability is maintained right until the seed is sown and begins to germinate. This gives the consistency and reliability in food production that growers can use to their advantage. In hydroponics, both commercial and small-scale growers rely on high-quality planting material, and the majority of this is grown from seed.

Commonly grown hydroponic crops that start as seed include tomatoes, cucumbers, peppers, melons, lettuce, many herbs and salad greens. Growers need consistent supplies of viable seed that germinates rapidly and produces strong, healthy seedlings. To achieve this seed producers grow



# NEW FROM TERRITORIAL SEED

Territorial Seed Co. offers these new seeds for hydroponic growers. (Photos courtesy Territorial Seed Co.)



**Rocky cucumber F1**—Bite-sized cucumbers, 2-3 inches long, seedless, fast maturing and prolific. Great for indoor and outdoor hydroponic growers.



**'King Tut' sweet pea**—A beautiful blue sweet pea, seeds of which are rumored to have been found in the tomb of King Tut! This is an unusual blue selection with vibrant color that grows up to 3 feet and would look great in any hydroponic display.



**'Holy Mole' F1 pepper**—For hydro pepper lovers! A hybrid pepper that gives more vigor, higher yields and earlier ripening than other types. Can be used for mole sauce or any dish that needs a great flavored pepper without extreme heat. Can be dried or ground for year-round use.



**Regal spinach F1**—Great for high-density sowing into hydroponic systems. Resistance to downy mildew. Erect leaves. Perfect for baby leaf production.



**'Golden Shine' F1 tomato**—For tomato buffs. Produces uniform 3-inch-round orange-yellow crack-resistant flavorful fruit. Indeterminate plants with good vigor.

**Other grower favorites...** Territorial Seed Co. reports that the most popular seed varieties in lettuce are loose-leaf types followed by butterhead and romaines. Multicolored varieties with memorable names such as 'Flashy', 'Trout's Back' and 'Speckles' are a good bet. With tomatoes, Brandywine is the most popular slicer. Most popular cherry tomato is flavorful Sun Gold.

specific plants purely for the production of seed.

In nature, there is usually a large amount of genetic variability between seedlings. This allows continued adaptation to the environment and a greater change of success of the species. However, in horticulture this sort of genetic variation between plants of the same species is not desirable, so seed is bred and produced to produce a crop that's as uniform as possible and has all the good characteristics the grower requires. Cultivars of self-pollinated crops can be propagated by seed with little variability occurring. These include some of our oldest crops such as wheat, barely and rice, which are naturally self-pollinating.

However, most species and cultivars are naturally cross-pollinated, which results in a lot of variability within the species, and which seed producers and plant breeders aim to control. There are several ways that this is done. However, in hydroponics, many of the crops we grow are hybridized resulting in uniform characteristics and improved growth patterns. A hybrid (most commonly F1 hybrid seed) is usually a cross between two inbred lines (first generation) of genetically different parents. This results in plants which are more vigorous than either parent. F1 hybrids now dominate commercial hydroponic production

of tomatoes, cucumbers, peppers, melons, many bedding plants, some herbs and even lettuce, due to their improved characteristics and uniformity. Because of the processes involved in producing hybrid seed, i.e., the parents of the hybrid line must be maintained as inbred lines or vegetatively propagated clones and the pollination process carefully carried out, the cost of hybrid seed is considerably more than that of open-pollinated types. However, the expense is usually more than compensated for with improved yields and crop growth.

Seed production also involves many other processes and procedures such as preventing unwanted cross pollination, removal of weeds which might produce seeds and cross contaminate the crop as well as off-type plants, testing of seed for viability and also growing the seed and testing it to be sure the cultivar produced is remaining true to type. Moisture levels, shelf life and seed lot purity are tested to ensure the seed remains viable for a certain length of time. Seed producers may treat seed after ripening and harvest or this may be carried out by other seed companies, closer to the point of sale. Once the seed has reached the correct moisture percentage, has been cleaned and graded, it is packaged to prolong the shelf life.

## What's New

A grower's seed preference often reflects their ideology about plants and food production in general. Many commercial growers, being economically focused, will choose the F1 hybrids specially bred for greenhouse or hydroponic production with high yields and multiple disease resistance. Sales of these types of seed into the commercial market is huge.

However, within the range of commercial hydroponic growers there are smaller producers, family farms, and those supplying direct to customers at farmers' markets and niche outlets where yields may not be the top priority. These growers are creating an increasing trend in sales of organically produced seed, untreated seed, older heirloom varieties and open-pollinated types. Seed companies state a number of reasons for these growing trends in diversity among commercial growers: some are simply responding to requests for certain types of fruits and vegetables from their customers, others just like to stick to what they have always grown and have a list of favorite seed varieties they buy each year, while others have a philosophy of maintaining genetic diversity and not letting the old varieties die out under the pressure of commercial production.

Among the smaller growers and hobby

hydroponic enthusiasts many are quite open to trying new seed types and treatments. However, it is in this category where sales of small packs of organic seed has skyrocketed and seems to be a trend for the future. Organically raised seed used to be rare, and often growers had to produce their own. Nowadays, the range of organic seed, both open-pollinated and even many organic hybrids, is quite amazing.

Some hydroponic producers want the best of both worlds, and many of these include the growing numbers of commercial organic hydroponic producers. These hydroponic growers need the increased vigor, disease resistance and characteristics of a hybrid varieties but must also use organically certified seed in their operations. The development of a good selection of organic hybrid seed has filled a number of market niches for seed, and many hydroponic producers are taking full advantage of this development in the seed industry.

Within the spectra of hydroponic growers it seems there is no one dominant trend in seed selection. Growers are as diverse as only growing large crops of intensively bred hybrid seed to those whose preference is for organically produced open-pollinated, untreated heirloom seed. Trends in the future are hard to predict, but we are already seeing some crossover in these seed categories, with seed companies reporting customers wanting seed that is both organic and hybrid. And we are already beginning to see variations on this with the development of organic seed which is coated with organically approved materials to create easy-to-handle pellets and conventionally raised seed being treated with organically approved compounds to assist sowing and germination.

## Seed Storage

One of my biggest problems with seed is seed storage and viability. Like hydroponic growers all over the world, I hoard and save open packets of seeds, often for years, not able to throw out something I might need in the future. This has led to quite an extensive stash of opened seed packets, some dating back a decade, and all squirreled away in the refrigerator taking up a

lot of space.

The problem then arises as to whether these seeds have lost viability. Will they germinate? And if they do, will the resulting seedling be weak and have lost vigor due to the length of time the seed was stored? In the past, it has been a rather frustrating experience sowing old packs of seed and hoping for the best. Sometimes I have been surprised by the rate of rapid and vigorous germination, most notably in tomatoes. Other times germination was a complete failure. Understanding what happens to a seed during storage and how to test for viability has proven to be highly useful for seed hoarders. It's also an important process for commercial hydroponic growers who might have concerns about seed viability in their operations.

How well a particular seed lot germinates depends on not only the qualities of the seed at harvest, but also how the seed was stored, both before and after sale to the grower. Seeds are living and respiring tissue. Seeds which remain viable the longest are those which have the largest nutrient store and those with a low moisture content. The water content of most ripe seed is very low, around 5%–20% of fresh weight, compared to 80%–85% for most live plant tissue. Drier seeds remain viable (able to germinate) for longer than moister ones.

Seed storage conditions aim to slow the rate of respiration and hence increase shelf life of viable seed. In particular, lower temperatures slow respiration and low humidity helps the seed keep its low moisture content. Since seed respiration uses oxygen, decreasing the oxygen supply also increases seed longevity. At the same time as slowing the rate of respiration, the embryo must be protected from conditions which may cause injury and reduce viability of the seed. Seed producers and seed companies tend to store seed under correct conditions and in suitable packaging marked with viability dates and seed lot testing information. However, growers are often unsure how to best store open packets of seed or how to recognize the signs that a seed lot has reduced vigor or has developed viability problems.

Most of the commercially produced

fruit, flower and vegetable seed purchased by hydroponic growers is higher value seed, packaged into air-tight and moisture-proof containers. This maintains the moisture level within the seed itself and prevents the effects of humidity which lowers shelf life. It also prevents contamination from pathogens. The decreased oxygen inside these sealed packs also acts to slow the rate of respiration and further prolong shelf life.

Once the seed packet or container has been opened and is no longer air tight, the seed is exposed to increased oxygen and humidity which can speed up the rate of respiration and lower the expected shelf life. Despite this, growers can use temperature control to prolong the viability of most seed as it is temperature that largely determines the rate of chemical reaction within the seed, including the rate of respiration.

Storage of seed in warm conditions hastens respiration and speeds up the depletion of the nutrient stores within the seed tissue. This is particularly important in tropical areas where high humidity and warm temperatures can rapidly result in seed losing viability. Both sealed and opened packets of seed are best stored at temperatures of less than 10 C (50 F). For most vegetable and other common seed refrigeration is a good option. Opened packets of seeds can be resealed or placed into a plastic container with desiccant. However, for species which have a limited shelf life, growers should only purchase the amount of seed required for immediate sowing, even if it means only buying in small quantities each season.

## Seed Viability Testing

The viability which is usually expressed as “percentage germination” of a seed lot is usually tested by the seed company. In commercial seed packs it's often printed on the outside of the seed container or package. The percentage “purity” may also be stated, and for high-quality vegetable seed this is usually close to 100%. Purity refers to the percentage by mass of pure seed and non-seed materials in the seed sample. Low purity means a higher percentage of weed seeds and other undesirable matter.

The germination percentage of most

seed lots should be relatively high. However, once the package has been opened and the seed has been exposed to the atmosphere for a while, this guaranteed germination does not apply. For this reason, growers should know how to viability test their own seed, so that seed which may have been stored from last season, or perhaps left out under warm conditions, can be reassessed, before valuable time and resources are used in sowing nonviable seed lots. Also, should problems arise during propagation, the seed lot can be double checked for viability problems before other causes are investigated. Many commercial growers have experienced losses from nonviable seed without realizing that this was the problem, and it can result in delays in production as well as weakened seedlings resulting from ageing seed.

By comparing the results of a recent viability test to the germination percentage printed on the seed packet, a grower can make a good estimation of how much viability has been reduced during longer term storage and if the seed lot is still worth sowing. With most of the crop plants we grow in hydroponics, unless the seed has been stored, opened in the greenhouse or somewhere warm for quite a while, it will generally have acceptable viability from season to season. However, a germination test can be a quick and easy process where valuable crops are at stake.

## Seed Testing

The germination percentage of a seed lot is how many seeds out of every 100 will sprout when given the optimum conditions of moisture, oxygen, temperature and light. This testing is carried out on moist filter paper, so that the seeds that do germinate can be easily seen and counted after a certain number of days. In the seed testing lab, petri dishes lined with sterile filter paper and distilled water are used so that no contamination from pathogens which might upset the viability test occurs.

However, growers can easily carry out this testing using clean plastic plates enclosed in a plastic bag or covered with clear plastic wrap with thick paper towels to hold moisture. Water should be boiled and cooled before wetting the paper and seeds carefully sprinkled over the surface.

For maximum accuracy, two containers, each with at least 20 seeds, should be used for each test. This provides replication of the results while making it easier to count seeds which have and haven't germinated. The seed dishes need to be placed in an environment that provides the correct warmth for germination, and this is species dependant. Warmer season species such as tomatoes should be germination tested at approximately 22-24 C, while lettuce is best tested at cooler temperatures, 12-14 C. High temperatures could induce dormancy in lettuce seed and result in a failed test. Each day the filter paper or paper towel should be checked to make sure it is still saturated with water and the number of seeds which have germinated can be counted. Seed is considered to have germinated when the radicle (young root) has emerged from the seed coat. The test can be stopped when no further seeds germinate for three days in succession. Any seed which has not germinated at this stage can be considered nonviable.

For a trial of 20 seeds, the number which have germinated at the end of the test can be multiplied by 5 to give the percentage germination. This percentage can be compared back to that given on the seed pack. If it has fallen considerably, it may not be economic to sow the seed lot as many germination misses will occur. A slight reduction in the percentage germination is normal in open seed packs and some species of crop seed have a naturally lower germination percentage than others. Certain types of plants also loose viability much faster than others, and growers may want to check that they have been supplied with fresh seed with these types of plants. One example of this is with gerbera seed where the percentage germination can fall quite rapidly with time from harvest. Growers may want to check a large seed lot before sowing.

Growers who collect their own seed should also make use of germination testing, as many factors can influence the viability of this type of seed. If the seed was not completely ripe at harvest, or was not dried down to a suitable moisture level for storage, or is contaminated with rot pathogens which develop as soon as the seed is

moistened, or has other viability problems, a germination test will show these up quickly.

Germination testing is also a great classroom science project for younger hydroponic growers. Results can be obtained within a few days for most types of plants. Testing the percentage germination of a number of different plant species or seed that has been stored under different conditions, or hand-collected, can give surprising results and it also allows an examination of the germination process in different types of seeds as well. By varying the germination temperature, away from the optimum for each species of plant, it's possible to see the effects of warmth or cold on the rate of germination.

Next time I'll look at some hot picks for hydroponic growers and the latest and greatest in varieties, seed treatments and germination equipment. 🌱

*Together with Simon Lennard, Lynette Morgan is co-ownwer of SUNTEC Hydroponic Consultants, New Zealand ([www.suntec.co.nz](http://www.suntec.co.nz)).*

## Resources

**Burpee Garden Products** ([www.burpeeseeds.com](http://www.burpeeseeds.com))  
**CropKing** ([www.cropking.com](http://www.cropking.com) (commercial) [www.carefreegarden.com](http://www.carefreegarden.com) (hobby))  
Seed and germination equipment for hydroponics.  
**DeRuiter Seeds** ([www.deruiterusa.com](http://www.deruiterusa.com))  
**Harris Seed** ([www.harrisseed.com](http://www.harrisseed.com))  
**Heirloom Seeds** ([www.heirloomseeds.com](http://www.heirloomseeds.com))  
**HydroFarm** ([www.hydrofarm.com](http://www.hydrofarm.com))  
[www.hydrofarm.com/content/seedstart.html](http://www.hydrofarm.com/content/seedstart.html)  
Germination station, heated germination mats/hothouse  
**Johnny's Selected Seeds** ([www.johnnyseeds.com](http://www.johnnyseeds.com))  
**Seminis Seeds** ([us.seminis.com](http://us.seminis.com))  
**Stokes Seeds** ([www.stokeseed.com](http://www.stokeseed.com))  
**Territorial Seed Co.** ([www.territorial-seed.com](http://www.territorial-seed.com))  
**Worm's Way** ([www.wormsway.com](http://www.wormsway.com))  
Heated germination mats and other supplies.