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# SEED GROWER'S MANUAL v 1.0

## 2019

## 1. INTRODUCTION

Thank you very much for your interest in growing seed stock for our seed catalog to help us promote biological diversity, and preserve our future food sources and seed varieties.

Two Seeds in a Pod is a family and farmer-owned small seed company that was co-founded by, Mehmet Öztan, and his wife, Amy Thompson, in Tampa, FL, in 2013. In less than five years, we grew and evaluated hundreds of open-pollinated seed varieties and introduced more than 60 rare, all open-pollinated, mostly heirloom vegetable and herb seeds to the U.S. seed market. Some of our seeds became staple varieties for farmers and growers in Tampa Bay Region and beyond.

In June 2018, we decided to move to Morgantown, when Amy accepted a job offer from West Virginia University (WVU). West Virginia's deep farming memory and traditions also helped with our decision as we anticipate to learn a lot from the Appalachia Region to expand our farm operation and seed catalog through local and regional collaborations. We now also will have the opportunity to produce and offer seeds for the crops that Florida's growing conditions weren't ideal for.

Five months after our arrival to Morgantown, WV, we found the land and home that we had been looking for to move our seed production and research farm in Reedsville, WV. In addition to farming for seeds, I will also be working in the Department of Geology & Geography at WVU as part of his service to the Community in fields related to

Appalachian heirloom seed preservation and agricultural production as well as in other food-related projects.

We will utilize our farm to evaluate new seed varieties, to research Appalachian and Turkish heirlooms, to raise seed stock for our catalog, and to transition into breeding new open-pollinated varieties. Our farm will also be used for educational purposes related to seed farming and preservation of heirloom seeds. At this point, we are not able to produce seeds for all our staple varieties year after year anymore, mainly due to the risk of cross-pollination and the increasing number of varieties we would like to keep fresh seeds for in our catalog. As a result, we are seeking to primarily collaborate with local and regional farmers. We also would like to work with farmers in other regions of the U.S. to produce seed stock for our adaptable varieties.

This manual aims to provide information about our contract prices, seed delivery conditions and other essential elements needed for the growers we work with to successfully fulfill a seed growing assignment. The guidelines given here are meant to offer an introduction to seed saving for beginner-level growers. Over time, every grower finds their own routine of harvesting seeds for each crop they grow. If you are an experienced grower, we assume that you already know many of the keypoints addressed here.

## 2. 2019 SEED PRODUCTION PRICES AND DELIVERY CONDITIONS

### 2.1. Contract Prices

| Seed Crop | Unit Weight | Price ($) |
|---|---|---|
| Beans | lb | 10 |
| Beet | lb | 40 |
| Black-eye Peas | lb | 12 |
| Cabbage | lb | 70 |
| Carrots | lb | 70 |
| Cauliflower | lb | 70 |
| Collard Greens | lb | 70 |
| Corn (field) | lb | 7.5 |
| Cucumber | lb | 60 |
| Eggplant | oz | 25 |
| Gourds | lb | 60 |
| Lettuce | oz | 20 |
| Melon | lb | 65 |
| Okra | lb | 30 |
| Peas | lb | 10 |
| Peppers | oz | 30 |
| Radishes | lb | 40 |
| Soybeans | lb | 12 |
| Summer Squash | lb | 60 |
| Sunflower | lb | 40 |
| Tomatoes | oz | 30 |
| Turnips | lb | 70 |
| Watermelon | lb | 65 |
| Winter Squash | lb | 60 |

**Table 1. 2019 seed production contract prices.**

Prices for the 2019 growing season for each seed-crop assignment are given in Table 1. While we typically pay the prices given in the table, prices may vary from one year to another, depending on the quantity we need to be produced, the rarity of the variety, and the condition of the volume of our sales given the fact that we are a very small seed company.

We will set up the contract prices when the assignments are made, based on what we need and what you are willing to grow. Once your seed crops are assigned to you, we will send you the actual contract that, if applicable, will override any prices provided in

this manual. For example, for paste tomato varieties which have less seeds than cherry tomatoes, unit weight price we pay will be higher.

If you end up producing more seeds than you are assigned for in your contract, we also will do our best to purchase the extra seeds up to as much as %25 of your contracted seed weight, as long as our contract budget allows us to do so.

While certain crops, when produced in certain quantities, can be profitable for you, you may not want to commit to seed assignments for other crops due to your limitations such as required labor and space allocation. You can also benefit from the seed production economic analysis chart (Appendix A) to decide which seed crops you would like to grow for us.

We will supply your foundation seed stock for the contracted seed variety at no charge, unless there is a special arrangement made prior to preparing your contract.

### 2.2. Communication

Effective communication is essential for fulfilling a seed production contract successfully, and for us to be able to help you to take measures in case of emergencies and with issues related to seed harvest. Please do not hesitate to contact us if you have any questions or need any help with regards to diseases, pests and other growing information. If you think that you will have a crop failure for a seed variety you are assigned, please let us know immediately.

### 2.3. Cleaning Seeds and Testing for Germination

Please thoroughly clean your seeds after harvesting them using the methods described in section 3.2. In addition, we expect that the seeds you deliver are not contaminated with noxious weed seeds. List of the noxious weeds of West Virginia is given in Appendix B.

If, during or after cleaning seeds, you spill any seeds on the ground by accident, please do not pick the seeds; otherwise you may end up introducing stray seeds to your main batch. Also, in between harvesting different seed crops, please make sure to clean the containers that you use for seed harvest.

We suggest you to conduct an informal, preliminary germination test by **1 October, 2019**, before you deliver the seeds to us, and compare the results to the federal germination standards for vegetable seeds provided in Appendix C for quality control purposes. You can do this simply by planting 100 seeds for the variety you would like to test in seed starting medium of your choice, and counting how many seeds germinated

to find out the germination percentage of your seed crop. You can use a seedling tray with drainage holes to conduct the test.

### 2.4. Delivery and Payment

All the prices on your contract will be paid for the clean and ready-to-pack seeds delivered before **31 October, 2019**.

If the seeds we receive from you are not clean and we end up re-cleaning your batch, we may have to deduct for the time we spend on cleaning seeds from your total payment, or we may have to reject the seeds we receive, depending on the condition of the batch.

Once we receive the seeds, we will formally test them for germination rates. If the test results for the seeds you deliver are lower than the federal standards, we reserve the right to reject the seeds we receive. Please keep in mind that, we overall aim for germination rates that are at least 10% higher than the federal standards.

Seeds of some food crops (e.g. eggplant, lettuce, peppers) show dormancy after being harvested and processed. In other words, freshly harvested seeds may not germinate if tested right away, and they may need more time for a germination test, a factor which may delay payment for a contract. That being said, we aim to pay for contracted seed assignments within 90 days of seed delivery, upon completion of our germination tests.

## 3. SEED SAVING GUIDELINES

We are adamantly dedicated to creating local foodways and regional seed networks, and delighted to prioritize working with local and regional farmers and growers while we also appreciate the chance to work with farmers and growers in different parts of the U.S. Regardless you are a home gardener or a small farmer, you are equally important to building up our seed stock. In addition, while we would enjoy working with experienced growers, we also cherish the idea of having beginner-level seed producers involved for not only educational process but also to help expand the seed-saving communities nationwide.

Producing seeds from a plant is not wildly different than growing that plant for market or for personal use; however, it requires better observation skills and patience. It also requires that adequate isolation distances between varieties of the same crop to be honored to eliminate cross-pollination of those varieties. These distances vary from one crop to another. If you have limited farming space that won't allow you maintain the isolation distances recommended in this manual, isolation methods in conjunction with hand-pollination can also be used. Isolating two varieties of the same specie with time, by planting one of them earlier so that it completes its pollination cycle before the later variety blooms, is another method. In summary, it is important that you take the time to consider how your field plans will be affected if you decide to grow a seed crop for us. If you think that you will be able to maintain seed purity, and the seed crop you are interested in growing for us will not interfere with your other field plans, please only then accept the assignment.

For example, two summer squash (*Cucurbita pepo*) varieties can easily cross with each other. If you are not isolating your plants in any way, if you are not hand-pollinating, and if you are assigned to grow a summer squash variety for us, then we recommend you to only grow that variety of summer squash in your garden/field. On the other hand, while it still can happen, risk of cross-pollination is substantially reduced for certain crops such as Nightshade family plants due to their flower structure so it would be possible to grow multiple varieties of these crops in the same field in one given season, depending on your field/garden size, without bagging flowers.

### 3.1. Isolation Distances for Certain Seed Crops

Following information and recommendations are compiled based on Suzanne Ashworth's Seed to Seed, Suzanne Ashworth's Seed to Seed: Seed Saving and Growing Techniques for Vegetable Growers, John Navazio's The Organic Seed Grower: A Farmer's Guide to Vegetable Seed Production, Organic Seed Alliance's A Seed Saving Guide, and our past experiences of growing seed crops.

Please keep in mind that in our applications, we also hand-pollinate and use physical barriers and/or isolation materials such as cages, isolation tents, blossom bags, and we isolate plants by timing through staggered planting of different varieties of the same specie. In other words, you can substantially reduce the isolation distance requirements given in this manual, by using any or a combination of various tools and methods.

**Bean (green and dry), common (*Phaseolus vulgaris*):** Common beans have self-pollinating, closed and perfect flowers, and it is recommended to keep 10-20 ft of isolation distance between different varieties of seed crops.

**Cabbage (*Brassica oleracea L.*):** Cabbages are outbreeding plants, their flowers get pollinated by insects, they can easily cross-pollinate with other cabbage varieties and other members of cole crops (i.e. cauliflower, Brussels sprouts, heading and sprouting broccoli, kale and collards, and kohlrabi), and it is recommended to keep 0.5-2.0 mi of isolation distance between different varieties of cole crops.

**Carrot (*Daucus carota L.*):** Carrots are outbreeding plants, their flowers get pollinated by insects, they can easily cross-pollinate with wild carrot or Queen Anne's Lace (*Daucus carota var. carota*), and it is recommended to keep 0.5-2 mi of isolation distance between different varieties of carrots.

**Collard (*Brassica oleracea L.*):** Collards are outbreeding plants, their flowers get pollinated by insects, they can easily cross-pollinate with other collard varieties and other members of cole crops (i.e. cabbage, cauliflower, Brussels sprouts, heading and sprouting broccoli, kale, and kohlrabi), and it is recommended to keep 0.5-2.0 mi of isolation distance between different varieties of cole crops.

**Cucumber (*Cucumis sativus*):** Cucumbers are outbreeding plants, their flowers get pollinated by insects, and it is recommended to keep 0.5-2.0 mi of isolation distance between different varieties of cucumbers.

**Eggplant (*Solanum melongena*):** Eggplant has self-pollinating, closed and perfect flowers, and it is recommended to keep 10-50 ft of isolation distance between different varieties of seed crops.

**Lettuce (*Lactuca sativa*):** Lettuces are inbreeding plants with closed and perfect flowers, and it is usually recommended to isolate different varieties of lettuce seed crops by 25 ft.

**Melon (*Cucumis melo*):** Melons are insect-pollinated plants, and it is recommended that different varieties of melons need to be isolated by 0.5-2.0 mi.

**Okra (*Abelmoschus esculentus*):** Okra flowers are self-pollinating; however, they can get attractive to bees because of their large size, and isolation requirement may be as high as 0.2 mi.

**Pea (*Pisum sativum*):** Peas have self-pollinating, perfect flowers, and it is recommended to keep 10-20 ft of isolation distance between different varieties of seed crops.

**Pepper (*Capsicum spp.*):** Pepper flowers are largely self-pollinating; however, risk of cross-pollination increases in hot types due to their flower structure, and it is recommended to keep 75-300 ft of isolation distance between different varieties of seed crops.

**Radish (*Raphanus sativus*):** Radishes are outbreeding plants that are insect-pollinated, and any two radish varieties must be separated by 0.5 mi.

**Squash (Cucurbita spp.):** Squash is insect-pollinated and it is recommended that different varieties of the same species of squash need to be isolated by 0.5-2.0 mi while *Cucurbita pepo* (i.e. main specie for commercial summer squash), *Cucurbita maxima* and *Cucurbita moschata* (i.e. main species for commercial winter squash) don't readily cross with each other (i.e. chances are extremely low), and it is acceptable to plant one variety of each of these species together in most cases.

**Tomato (*Solanum lycopersicum*):** Tomatoes are self-pollinating plants, and it is recommended to separate tomato varieties by 20 ft while potato-leaf varieties (oftentimes these are old heirlooms) require more isolation.

**Watermelon (*Citrullus lanatus*):** Watermelon is an outbreeding plant, all varieties of watermelon will cross with each other, and 0.5-2.0 mi of isolation is recommended to maintain seed purity.

In light of the information provided in this section, you can also use Table 2 to have a rough idea whether you can grow multiple varieties of one seed crop in the same season in your field or garden under reduced isolation conditions.

| Seed Crop | Multiple Varieties in the Same Field |
|---|---|
| Beans | Doable |
| Beet | **No** |
| Black-eye Peas | Doable |
| Cabbage | **No** |
| Carrots | **No** |
| Cauliflower | **No** |
| Collard Greens | **No** |
| Corn | **No** |
| Cucumbers | **No** |
| Eggplant | Doable |
| Gourds | **No** |
| Lettuce | Doable |
| Melon | **No** |
| Okra | **No** |
| Peas | Doable |
| Peppers | Doable |
| Radishes | **No** |
| Soybeans | Doable |
| Summer Squash | **No** |
| Sunflower | **No** |
| Tomatoes | Doable |
| Watermelon | **No** |
| Winter Squash | **No** |

**Table 2. Growing arrangements for certain seed crops.**

## 3.2. Seed Harvest

**3.2.1. Dry seed harvest.** This category covers the crops of which seeds mature in a pod and are dried on a surface.

**Bean, cowpea and garden pea.** Cut the plant when the majority of the pods turns tan color and leathery. Dry the pods for a week, out of direct sun, on a flat surface with good air circulation until seeds rattle in the pods. Thresh the pods to release the seeds without applying too much pressure. Winnow the chaff with fan. Avoid waiting until the pods turn dark brown before harvesting, as you may end up with shattered seeds. Cowpeas may need a few more days than beans and garden peas to dry.

**Brassicas.** Cabbage, collard greens, Brussels sprouts, cauliflower and kale need to be over-wintered to encourage flower production. If in your climate zone, temperatures

don’t go below 20F, you can let the plants over-winter in the field. If you are in a colder zone, pull the cabbage plants with heads and roots intact, trim the roots up to a foot. Store the plants at 35-38F and 90-95% relative humidity in mold-free, clean wooden totes made from slotted planks to allow air and humidity flow. Cover the plants with wood shavings.

Re-plant in spring. Eventually, flower stalks emerge to form seeds. If the heads are too tight, stalks can also be encouraged to emerge by gently slicing an X on the top of the heads. Make sure that the slice is shallow.

Harvest seed pods when they turn brown. Thresh by rubbing the pods to release the seeds, and winnow. Be careful not to apply too much pressure while rubbing pods, otherwise seeds may get damaged.

Kale, collard greens, Brussels sprouts and cauliflower can be processed for seeds the same way as cabbage.

**Carrot.** Carrot is a biennial crop and needs to be over-wintered to flower. If your climate gets too cold to over-winter your carrot crop in the field, then dig up the roots and select them based on the variety’s typical characteristics for size, shape, flavor etc. Trim the tops to 1 inch. Store the roots either in wooden totes mentioned earlier or in your root cellar, if any. Make sure that the roots don’t touch each other and cover them with woodchips.

Re-plant the roots in spring. At seed maturity, seeds will turn brown. Umbels that first form seeds on a plant offer the best quality seeds. To improve the seed quality, cut and discard the later umbels. When the majority of the seeds turn brown, cut the stems and lay them on a tarp for a few days to let them dry. Seeds can easily get detached from the umbels so keep the umbels away from wind and rain.

**Corn.** Let the ears completely dry on the stalks. Leave the shucks on the ears, and dry the ears for around 2 more weeks before harvesting seeds.

**Lettuce.** Lettuce seeds mature 2 weeks after the plants flower. If the majority of the flowers on a single plant develop a “feather” look, then you can dig the plants with the roots being intact and let 1) the mature seeds dry completely, and 2) developing seeds mature on a tarp for around a week. Cut the rootballs at the time of seed harvest, and knock the seeds off either on a tarp or into a bucket. Try to harvest all the seeds from one batch of planting at once.

**Okra.** Allow the seed pods to mature until they turn brown and split. Put gloves on and cut the pods. Let the pods dry for around a week and harvest the seeds.

**Onion.** Onion is a biennial crop, and needs to be over-wintered. Pull the plants at the time of bulb maturity, and select the roots to over-winter. Follow the steps described in the carrot section for storage details.

Re-plant roots in spring, and let the plants flower. Cut the umbels, leaving a few inches of stem attached, and lay them on greenhouse tables covered with landscape fabric or tarp to dry, making sure that a good airflow is maintained.

**Pepper.** While majority of pepper varieties turns red when the seeds are mature, flesh color may vary. After picking the pods, you can store them for around a week to improve the seed quality; however, make sure that the storage temperature is not more than 70F to ensure that the germination rates stay high. Take the seeds out on a plate that won't stick to them, and let them dry for 2 weeks. When you harvest hot pepper seeds, make sure to wear gloves during harvest, and wash your hands thoroughly once you are done, before you touch any body parts. While, in our experience, letting pods ripen on the plant delivers the best quality seeds, if you observe any decay on fruits at ripening stage, pick them immediately to let them finish ripening off the plant.

#### 3.2.2. Wet seed harvest.

Methods in this category are used to harvest seeds from crops that produce wet flesh at seed maturity.

Fermentation method is very effective for removing the gel layer around the seed that acts as a germination inhibitor. The method delivers very clean seeds by removing the pulp around them and is known to eliminate certain diseases.

**Cucumber.** Cucumbers are usually ready to process for seeds, 4-6 weeks later than the fresh-produce quality stage on the vine is reached. At seed maturity, fruits are usually 2-3 times larger than the fresh cucumbers on a specific plant. Fruits with mature seeds also turn a pale yellow or brown, another indication to help initiate the seed harvesting process. Cure the fruits you pick at room temperature, away from rodents, for two weeks. Slice the fruits, and scoop the flesh into a plastic container. Let the mixture ferment for 36-48 hours. Stir the mixture twice a day to aerate. Rinse and spread the seeds on a surface with good air circulation, and let them dry for 2-3 weeks.

**Eggplant.** Seeds of eggplant mature around 3 weeks later than the fruits' edible stage. Purple varieties usually turn dull brown while the white ones turn yellow at seed maturity. Pick the fruits when you observe the color change, and cut them into smaller chunks, add water, and blend in a food processor. Make sure to have either a dull metal or a plastic blade to not to damage the seeds. Once the flesh is blended evenly, transfer the mix to a bowl filled with water and remove the big chunks as well as floating

material. Decant the seeds into a colander, rinse and spread them on a surface with good air circulation. Let the seeds dry for 2-3 weeks.

**Melon.** Pick the melons at eating quality to cut open them and scrape the seeds out. Rinse the seeds thoroughly and let them dry for 2-3 weeks. If there is no sign of disease at the time of maturity, you can leave them in the field until the rind softens, to improve the seed quality.

**Squash, Summer.** Seeds of summer squash mature around 6 weeks later than the fruit's edible stage. At seed maturity, fruits become very large and hard, and the fruit stems dry up. At this stage, you can pick the fruits, scrape the seeds and rinse them to dry for 2-3 weeks. If there is no sign of disease, you can also keep the fruits on the vine until the plants completely die or before the frost kills the plants.

**Squash, Winter.** At full fruit maturity, if the fruits don't show any sign of disease, store the fruits at around 70F for 2 months for improved seed quality. After storage, cut the fruits open, scrape the seeds out, and let them dry for 2-3 weeks. If you don't have proper storage conditions or if the fruits show sign of disease, harvest the seeds immediately once the fruits are ripe.

**Tomato.** Scoop the seeds and the pulp into a plastic container to ferment. Alternatively, you can also crush the whole tomatoes into a container to ferment. Let the container sit at room temperature. Stir the mixture twice a day to aerate. Fermentation process usually takes 36-48 hours. Seeds are usually ready to harvest when a layer of white mold forms on mixture surface. You can also occasionally take seeds out of the container and rub them gently between your fingers to check whether they still feel slimy (i.e. whether the gel layer is removed). If not, fermentation is finished. If you find sprouted seeds in the mixture, this means that your seed batch has been over-fermented and is damaged. Paste tomatoes are usually meaty and have less juice than fresh-eating tomatoes, making the mixture thick. In this case, you can add an equal volume of water to the crushed tomatoes to initiate the fermentation. When fermentation is done, rinse the seeds. Spread the seeds and let them dry for 2 weeks.

**Watermelon.** Harvest the fruits at full ripeness, scoop their flesh out into a container and let the mixture sit for 6-10 hours. Rinse the seeds and let them dry for 2-3 weeks. If there is no disease pressure present, you can leave the fruits on the vine longer to improve the seed quality. If there is any sign of decay on the fruits, harvest them immediately.

### 3.3. Diseases and Crop Failures

Observing your seed crops closely is very helpful for identifying disease-related problems and crop failures. Healthy seeds produce healthy crops so we expect that the seeds you deliver us to be harvested from healthy plants. If you observe any signs of stunted growth, wrinkled leaves, fruit deterioration, please contact us with photos immediately.

Certain diseases pass through seeds. Hence, please avoid saving seeds from sick plants. Similarly, if you touched a plant with a sign of disease, using hand-sanitizer before touching other plants would help not spreading diseases in your field.

When we used to farm in Florida, season after season, we consistently observed that incorporating *mycorrhizae* into poor Florida soil significantly improved plant health, vigor and yield in our controlled grow-outs. We also believe that beneficial soil microbes improved flavor for us, due to their ability to help plants uptake micronutrients more efficiently. Please keep in mind that, if you have healthy soil that is built with good quality compost and that has good aeration and drainage skills, then your soil is probably rich in beneficial soil microbes as well. In our applications, we usually applied mycorrhizae in planting hole, around the root zone, at the time of transplanting. A costly but high quality commercial brand for this purpose would be Plant Success.

Never overwater your plants. If a substantial amount of water is readily available close to ground surface, plants will keep their roots close to surface and won't develop deep root systems. Deeper the roots better the plants uptake nutrients around root zone and micro-nutrients available in deeper soil profile, hence the better plant health.

Never water your seed crop from top, especially at the time of flowering. Watering from top would not only negatively impact proper pollination but it will also encourage diseases, especially in humid regions.

### 3.4. Maintaining Genetic Diversity

Try to save and select seeds from as many plants that reflect the ideal characteristics of the variety you grow as you can, to have a better representation of it. In our experience, selecting seeds to capture typical traits of a specific variety is an endless effort. In a way, when we save seeds from the same variety season after season, we keep breeding and personalizing it. For your reference, minimum populations needed to maintain biodiversity for major seed crops are given in Table 3.

| Seed Crop | Minimum Population Needed to Maintain Biodiversity |
|---|---|
| Beans (common) | 10-20 |
| Black-eye Peas | 20-40 |
| Cabbage | 80 |
| Carrot | 200 |
| Cauliflower | 80 |
| Collard Greens | 80 |
| Corn | 200-300 |
| Cucumber | 10-20 |
| Eggplant | 20-40 |
| Lettuce | 10-20 |
| Melon | 10-20 |
| Okra | 20-40 |
| Peas | 10-20 |
| Peppers | 20-40 |
| Radish | 80 |
| Summer Squash | 10-20 |
| Tomatoes | 10-20 |
| Watermelon | 10-20 |
| Winter Squash | 10-20 |

**Table 3. Minimum plant population needed to maintain biodiversity.**

### 3.5. Plant Cycles

While some vegetable crops produce seeds annually, others do so biennially (see Table 4). An annual crop requires one growing season to complete its life cycle and to produce seeds, whereas a biennial crop requires two growing seasons to complete its life cycle and to produce seeds.

Biennial crops require vernalization over winter to flower so that they can flower and go to seed. Throughout the vernalization process, these crops need to be exposed to temperatures less than 50F for 8 to 12 weeks. You can refer to section 3.2. for details on harvesting seeds from some of these annual and biennial plants.

| Seed Crop | Seed Production Cycle |
|---|---|
| Bean, Common | Annual |
| Black-eye Pea | Annual |
| Cabbage | Biennial |
| Carrot | Biennial |
| Corn | Annual |
| Cucumber | Annual |
| Eggplant | Annual |
| Lettuce | Annual |
| Melon | Annual |
| Okra | Annual |
| Onion | Biennial |
| Pepper | Annual |
| Radish | Annual |
| Squash | Annual |
| Tomato | Annual |
| Watermelon | Annual |

**Table 4. Some annual and biennial crops.**

### 3.6. Other Issues

Some of you may have observed that a tomato variety you expect to produce large fruits randomly ending up producing medium-size, off-shape fruits in a given season, while it maintains its good flavor traits. Well, we did, too. There are academic studies which suggest that open-pollinated seeds may not be as stable as we think they are.

We also observed in various cases that, even when the seed crop is well-isolated, in extreme conditions (e.g. extreme heat, unexpected temperature variations), likelihood of ending up with mutated plants in the following season, grown from the seeds saved in the previous year, is not that little so be aware that mutations can happen due to environmental conditions.

Identifying the plants that don't reflect the desirable characteristics of a seed variety, and removing them from the field to improve the quality of the crop is called *roguing*. Roguing is very important when you grow your seed crops as it will help you only keep the plants that show little or no sign of disease, that demonstrate good plant vigor and other typical characteristics which will be represented by the seeds you harvest in the end.

## 4. GROWING AND SEED HARVESTING TIPS FOR FLORIDA FARMERS

This chapter is specifically written for Florida growers but many tips given here may also be applied to other regions. If you are a grower located in Florida, you probably are aware of the poor soil conditions of the State. Working a healthy amount of organic matter and compost into sand can significantly improve your growing conditions and help you create healthy soil.

Florida sand offers great drainage capability; however, drought is becoming a big problem in spring in certain locations of the State, and when combined with high temperatures, it becomes more challenging to keep the root zone of your plants moist. In addition to working compost into sand, mulching religiously can help both with decreasing watering frequency and conserving water.

### 4.1. Fermentation Method

While, in our opinion, fermentation method works best with tomatoes, with caution, it can also be used to harvest cucumber, melon and watermelon seeds. Although it is possible to grow early watermelon varieties in fall in Florida, when temperatures are milder, watermelon is usually a spring/early summer crop in the State. When the harvest time arrives, growing conditions get very hot and humid. Especially if you use the fermentation method to harvest watermelon seeds in summer, pay extra attention NOT TO leave the seeds in a bucket in fruit juice outside in the heat (even in shade) for an extented period of time. Always ferment your seeds indoors, where temperatures can be controlled.

We strongly recommend you to watch the fermentation process and separate the seeds from the pulp as soon as the desired “slimy” consistency is reached, meaning that the seeds can easily be collected from the mixture. In our experience, this timeframe is usually somewhere between 6-12 hours. If you leave the seeds unattended more than necessary in high heat, majority of the seeds will lose viability.

Similar rules apply to other wet seeds such as melons and tomatoes. It is a lot easier to observe the completion of the fermentation process as far as tomatoes are concerned.

### 4.2. Garlic Vernalization

Garlic can be successfully grown in all growing zones in Florida if the *seed* bulbs are properly vernalized. For this, we recommend you to store your bulbs in paper bags with punched aeration holes on them. Simply tie the paper bags with twist ties and store them in your refrigerator or in a cooler with around 40F ambient temperature. This process is called *vernalization* and can be also applied to certain winter crops (e.g.

cabbage, collard greens) that require specific winter temperatures for a time period to produce good quality seeds in the following year. Never store your bulbs in freezer. Keep the bulbs intact and do not detach the cloves at least until a few days before your garlic beds are ready to plant as separating the cloves will trigger them to sprout.

In Central Florida, vernalizing the bulbs for 10-12 weeks provides optimum results as far as size of the harvested bulbs goes. Please keep in mind that the longer you vernalize your seed bulbs, the larger bulbs you harvest in spring. Usually, hardneck varieties do better than the softneck ones in Florida's growing conditions.

### 4.3. Other Tips

You may experience difficulties with germinating lettuce seeds in Florida, when the temperatures are consistently higher than 80F. Certain romaine and Batavian lettuce varieties are known to germinate better in high heat conditions. You can also store your lettuce seeds in your refrigerator for around five days before planting them to improve the germination rates.

Florida soil has nematodes, making it a challenge to grow tomatoes. *Chitin* may help you reduce nematode pressure and the occurence of related diseases. Shrimp meal naturally has chitin, and is rich for Ca and Mg, all of which help grow a healthy tomato crop. We highly recommend you to incorporate shrimp meal and/or other chitin-based organic matter into your rows, preferably before the planting season so that the organic matter can be decomposed by beneficial soil microbes before your plants start fruiting. When we used to farm in Florida, we grew the best tomatoes in fall season, seeds being started end of August/early September. Lately, drought have been a serious challenge for farming in spring in Florida. Surround WP, a micronized clay product, may help your crops and especially your tomatoes to cope with heat pressure.

After harvest, make sure to dry the seeds on a single layer with as much surface area as you can spare. Heat in combination with humidity may make seeds germinate while they are drying, if the drying process isn't completed in a timely manner. This may especially become a problem with small seeds such as eggplant, ground cherry and tomatillo. We recommend you to use a fan pointed at your drying platform and turn the seeds every once a while to make sure they dry faster.

In Florida, especially when humidity is consistently very high throughout successive rain events, powdery and downy mildew become two major diseases for cucurbits, more so for cucumbers, summer squash and melons. If mildew has already taken over the majority of the plant's canopy, it is most probably very late to reduce mildew pressure.

However, GreenCure, a commercial fungicide, very effectively worked for us to reduce mildew pressure in our field, when we applied it at first sign of mildew.

## 5. ESTIMATING AND IMPROVING SEED YIELDS

Keep in mind that the growing methods you use will greatly affect your seed yields. Seed crops overwhelmed by weeds, poor soil fertility, overhead watering, excessive watering and pests are some of the factors that reduce yields.

We recommend you to start your seedlings as early as possible in the greenhouse and transplant them after the last frost in your growing zone to get better seed yields than direct-seeded crops. Direct-seeded plants will also oftentimes bolt earlier than transplanted plants. Also, we many times observed that varieties planted in smaller populations and tended closely produced better seed yields than those were planted in large quantities.

In Appendix D, we provide a list of estimated seed yields for major vegetable crops. This list is a composite of Small-scale Organic Seed Production, prepared by Patrick Steiner, Knott's Handbook for Vegetable Growers, written by Donal N. Maynard and George J. Hochmuth, as well as our field experiences and the data we have collected over time. The list is only intended to help you with your growing plans and give you a rough idea about seed yields as they will not only vary depending on the season and the growing conditions mentioned above, they will also vary from one variety of a given plant type to another (i.e. seed yield of a paste tomato will be different than that of a fresh-eating tomato). Certain values in the list were averaged and extrapolated from large-scale observations to give insight about potential small-scale yields.

**IMPORTANT:** Certified growers are already obliged to record certain data with regards to their harvest. Regardless you are a certified grower or not, we would greatly appreciate it if you may take detailed notes of how much of a crop you grow for each variety (i.e. how many plants or how long of a row) for us and how much seeds you harvest at the end of the season. Such information will greatly help us improve the cumulative list of seed yields and plan for seed production assignments more accurately.

## Appendix A: Seed production economic analysis chart (modified after Steiner)

**Seed Production Economic Analysis Chart**

| **Expenses** | **Cost ($)** | | | | | |
|---|---|---|---|---|---|---|
| Land | | | | | | |
| | **# hr** | **Cost/hr ($)** | | | | |
| Labor: planning | | | | | | |
| Labor: field work | | | | | | |
| Labor:<br>seed harvest and cleaning | | | | | | |
| Seed (planting stock) | | | | | | |
| Fertilizer/Soil Amendments | | | | | | |
| Pest Management | | | | | | |
| Water | | | | | | |
| Certification Fees | | | | | | |
| Equipment<br>(e.g. rentals, repair) | | | | | | |
| Indirect costs<br>(e.g. insurance) | | | | | | |
| **Total Cost ($)** | | | **Cost per Net Seed Yield ($)** | | | |
| **Sales** | **oz** | | **Sales/oz ($)** | **lb** | **Sales/lb ($)** | **Total Sales ($)** |
| Net Seed Yield<br>(weight after cleaning) | | | | | | |
| **Profit ($)** | | | | | | |
| Net Profit<br>(Total Sales-Total Cost) | | | | | | |
| Profit per Seed Yield | | | | | | |

## APPENDIX B: Noxious weeds of West Virginia

| Common Name | Latin Name |
|---|---|
| Autumn olive | Elaeagnus umbellata Thunb. |
| Bindweed | Convolvulus arvensis |
| Canadian thistle | Cirsium arvense |
| Curled thistle | Carduus crispus L. |
| Dodder | Cuscuta spp. |
| Galinsoga | Galinsoga parviflora |
| Johnsongrass | Sorghum halpens |
| Kudzu | Pueraria thunbergiana |
| Leafy spurge | Euphorbia esula |
| Marijuana | Cannabis sativa L. |
| Multiflora rose | Rosa multiflora Thunb. |
| Musk thistle | Carduus nutans L. |
| Opium poppy | Papaver somniferum L. |
| Perennial sow thistle | Sonchus arvensis |
| Plumeless thistle | Carduus acanthoides L. |
| Quackgrass | Elytrigia rapens |
| Wild garlic | Allium vineale |

## APPENDIX C: Federal germination standards for vegetable seeds

| Seed Crop | Federal Germination Standard (%) |
|---|---|
| Artichoke | 60 |
| Asparagus | 70 |
| Bean, yard-long | 75 |
| Bean, garden | 70 |
| Bean, lima | 70 |
| Bean, runner | 75 |
| Beet | 65 |
| Broadbean | 75 |
| Broccoli | 75 |
| Brussels sprouts | 70 |
| Cabbage | 75 |
| Cardoon | 60 |
| Carrot | 55 |
| Cauliflower | 75 |
| Celeriac | 55 |
| Celery | 55 |
| Chard, Swiss | 65 |
| Chicory | 65 |
| Chinese cabbage | 75 |
| Chives | 50 |
| Citron | 65 |
| Collards | 80 |
| Corn, sweet | 75 |
| Cornsalad | 70 |
| Cowpea | 75 |
| Cress, garden | 75 |
| Cress, upland | 60 |
| Cress, water | 40 |
| Cucumber | 80 |
| Dandelion | 60 |
| Dill | 60 |
| Eggplant | 60 |
| Endive | 70 |
| Kale | 75 |
| Kohlrabi | 75 |
| Leek | 60 |
| Lettuce | 80 |
| Melon | 75 |
| Mustard | 75 |

## APPENDIX C: Federal germination standards for vegetable seeds cont'd.

| Seed Crop | Federal Germination Standard (%) |
|---|---|
| Okra | 50 |
| Onion | 70 |
| Onion, Welsh | 70 |
| Pak-choi | 75 |
| Parsley | 60 |
| Parsnip | 60 |
| Pea | 80 |
| Pepper | 55 |
| Pumpkin | 75 |
| Radish | 75 |
| Rhubarb | 60 |
| Rutabaga | 75 |
| Sage | 60 |
| Salsify | 75 |
| Savory, summer | 55 |
| Sorrel | 65 |
| Soybean | 75 |
| Spinach | 60 |
| Spinach, New Zealand | 40 |
| Squash | 75 |
| Tomato | 75 |
| Tomato, husk | 50 |
| Turnip | 80 |
| Watermelon | 70 |

## APPENDIX D: Estimated seed yields for major seed crops (modified after Steiner and Maynard & Hochmuth)

| Crop | Cultivar | Seed Yield Per 100 ft (lb) |
|---|---|---|
| Bean | Bush Bean | 7.5 |
| | Soybean | 12.0 |
| | Generic Pole | 7.3 |
| | Broad Windsor Fava | 13.5 |
| Beet | Detroit Dark Red | 13.3 |
| Broccoli | Generic | 10.0 |
| Brussels Sprouts | Generic | 10.0 |
| Burdock | Generic | 9.0 |
| Cantaloupe | Small, seedy varieties | 0.7 |
| Carrot | Long Orange Improved | 1.5 |
| | Generic Conventional | 7.5 |
| Cucumber | Boothby's Blonde | 3.2 |
| | Generic Pickling Conventional | 11.1 |
| Eggplant | Rosa Bianca | 1.3 |
| | Halep Karasi | 2.3 |
| Greens | Arugula | 2.3 |
| | Cress | 2.5 |
| | Kale | 4.2 |
| | Mizuna | 5.3 |
| | Mustard | 2.5 |
| | Mustard, Giant Red | 3.2 |
| | Mustard, Southern Curled | 17.0 |
| | Tatsoi | 1.7 |
| Kohlrabi | Generic | 5.0 |
| Leeks | Conventional | 4.0 |
| | Durabel | 1.9 |
| Lettuce | Generic Average | 1.3 |
| Onions | Early Yellow Globe Conventional | 3.7 |
| | Southport White Globe Conventional | 4.9 |
| Peas | Generic average | 6.7 |
| Peppers | Average | 1.8 |
| | Variety 1 | 3.6 |
| | Balik | 2.1 |
| | Mehmet's Sweet Turkish | 2.1 |
| | Sweet Chocolate | 0.7 |
| | Jimmy Nardello | 0.8 |
| | Ancho | 1.8 |
| Pumpkin | Long Pie | 5.1 |

## APPENDIX D: Estimated seed yields for major seed crops (modified after Steiner and Maynard & Hochmuth) cont'd

| Crop | Cultivar | Seed Yield Per 100 ft (lb) |
|---|---|---|
| Radish | Misato Rose (large roots) | 5.4 |
| | Rat Tail | 19.7 |
| | Pink Beauty (medium roots) | 0.9 |
| | Generic Conventional | 8.4 |
| Spinach | Bloomsdale Savoy | 16.2 |
| | Bloomsdale Conventional | 11.0 |
| Squash | Blue Hubbard Conventional | 6.3 |
| | Table Queen Conventional | 8.1 |
| Tomatoes | Variety 1 | 0.9 |
| | Variety 2 | 0.6 |
| | Variety 3 | 0.9 |
| Turnip | Shogone Conventional | 15.0 |
| Watermelon | Cekirdegi Oyali | 3.3 |
| | Generic, small, seedy | 2.2 |
| Flowers | Calendula | 6.2 |
| | Marigold, French | 0.7 |
| | Morning Glory | 1.7 |
| Herbs | Basil, Lemon | 6.8 |
| | Cilantro, Santo | 5.6 |