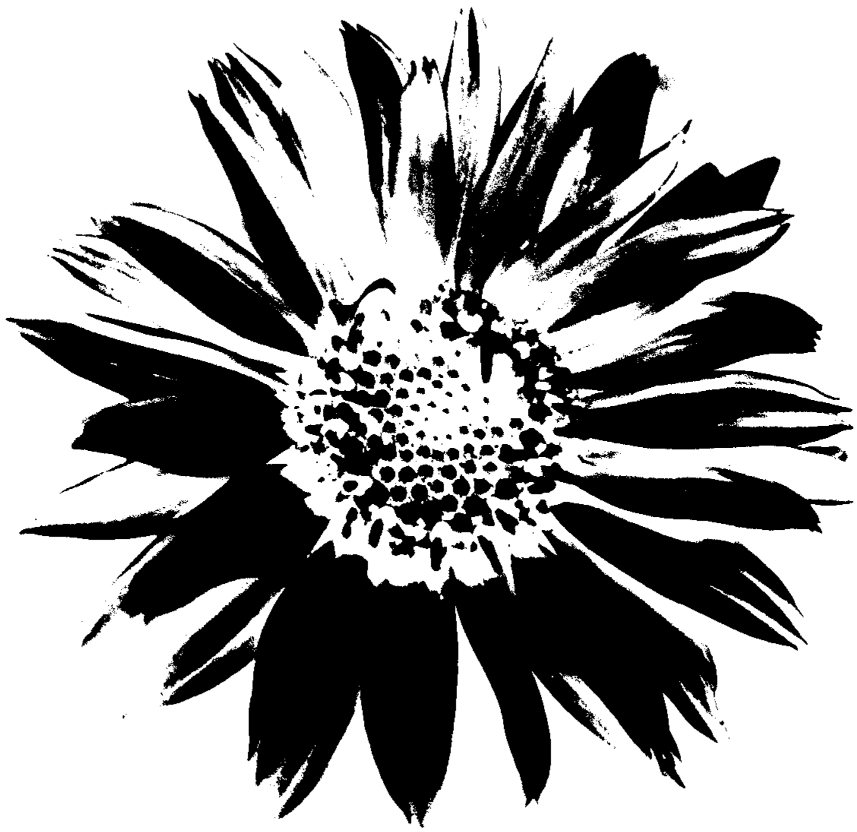
# SAVINGSEEDS

University California Santa Cruz



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# The Demeter Seed Library's guide to growing and saving seeds

**By Cole Thomas**

When agriculture developed more than 10,000 years ago, saving seeds from crops was an essential element of growing food (SCBD, 2014). By saving seeds from the most resilient and fruitful crops, farmers developed the well-adapted crop varieties we have today. For thousands of years, farmers maintained their farms by saving seeds for succeeding years.

Since the 1800s, agriculture has become increasingly globalized and industrial thanks in part to a growing dependence on synthetic fertilizers and pesticides to increase yields. Farmers also stopped saving seeds and began to buy seeds from vendors in order to cut costs and reduce labor inputs. In 1994, the FDA approved the first genetically modified crop, the "Flavr Savr tomato" (Coppola, 2013). Soybeans, corn, rice, cotton, canola and potatoes along with many other crops quickly followed the GM trend (ibid). Since GM seeds have flooded the agricultural market, companies like Monsanto and Syngenta have capitalized and bought out small seed companies, thus creating a seed oligopoly. Monsanto scientists genetically modified crops to be "Round-Up ready" so that farmers could spray the highly toxic chemical on their fields and kill all broadleaf plants except their GM crop. According to the USDA, farmers apply

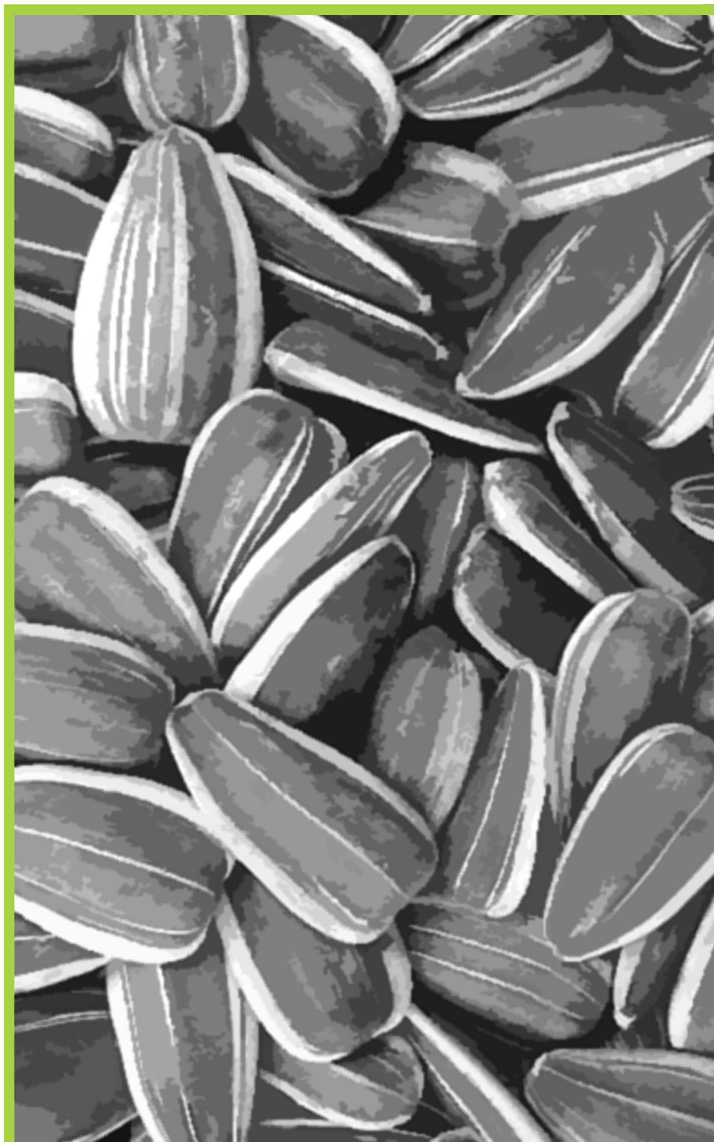
~26% more toxic chemicals on genetically modified crops then on non-GM crops (Paul & Cummins, 2013). The increased use of chemicals furthers the depletion of agro-ecosystem diversity. Monopoly of the seed supply by major corporations has depleted seed varieties, which ultimately inhibits the resilience of the global food system.

Agriculture biodiversity is defined as the "variety and variability of animals and plants, and micro-organisms, at the genetic, species and ecosystem levels, which are necessary to sustain key functions of the agro-ecosystem structure and processes" (SCBD, 2014). A classic example of what can happen when there is a lack of genetic biodiversity is the Irish Potato Famine of 1845. In Ireland, the Lumper variety of potato was the food staple and since potatoes can be propagated vegetatively, many were clones of each other (UC Berkeley, 2013). The genetic similarities allowed the fungus *Phytophthora infestans* to reduce the entire Irish potato stock into inedible slime (ibid). By 1855, 750,000 Irish people died due to the potato famine (Mintz & McNeil, 2013). The monopolization of seed markets and the shift to intensive large-scale agricultural systems has depleted the genetic variation in agro-ecosystems. According to the Food and Agriculture Organization of the United Nations, 75% of crop genetics has been lost in the past 100 years. As of 2010, wheat, rice, and maize alone provide for 50% of the global plant- based energy intake (SCBD, 2014. The depletion of agricultural biodiversity on a global scale is begging for a pandemic agricultural disaster; our global food system is not secure.

# University of California Santa Cruz
## Demeter Seed Library

The Demeter Seed Library is a UCSC student-run, organization of students, local farmers, and gardeners who believe in the importance of preserving the genetic heritage of our food. Our mission is to preserve and breed locally adapted cultivars and seed varieties on California's Central Coast. Our objective is to help gardeners and farmers access seeds and to educate youth and community members about the importance of biodiversity in our agricultural systems. Additionally, we manage a national web-based seed library social network (link: www.seedlibraries.org) to connect farmers and seed savers. Ultimately, our living seed library promotes the resiliency and autonomy of our local food system. We aim to demonstrate a society that is not reliant on large seed companies and multinational corporations that currently control the global food system.

We at the Demeter Seed Library conduct "grow-outs" to grow crop varieties to seed as well as work with local, organic farms to grow seeds. We catalog seeds and distribute them to farmers and gardeners. We encourage people who use our seeds to grow a portion of their crops through their lifecycle to bear seeds. We ENCOURAGE donations of both seed and/or money because we are always in need of both resources to increase our presence in the community. Please send seed donations to CASFS (Demeter Seed Project), 1156 High Street, Santa Cruz, CA 95064. Please include information of the seed variety, the date that they were grown, and where they were grown.



"75% of crop genetics have been lost in the past 100 years"

# Saving Seed
## Seed Development

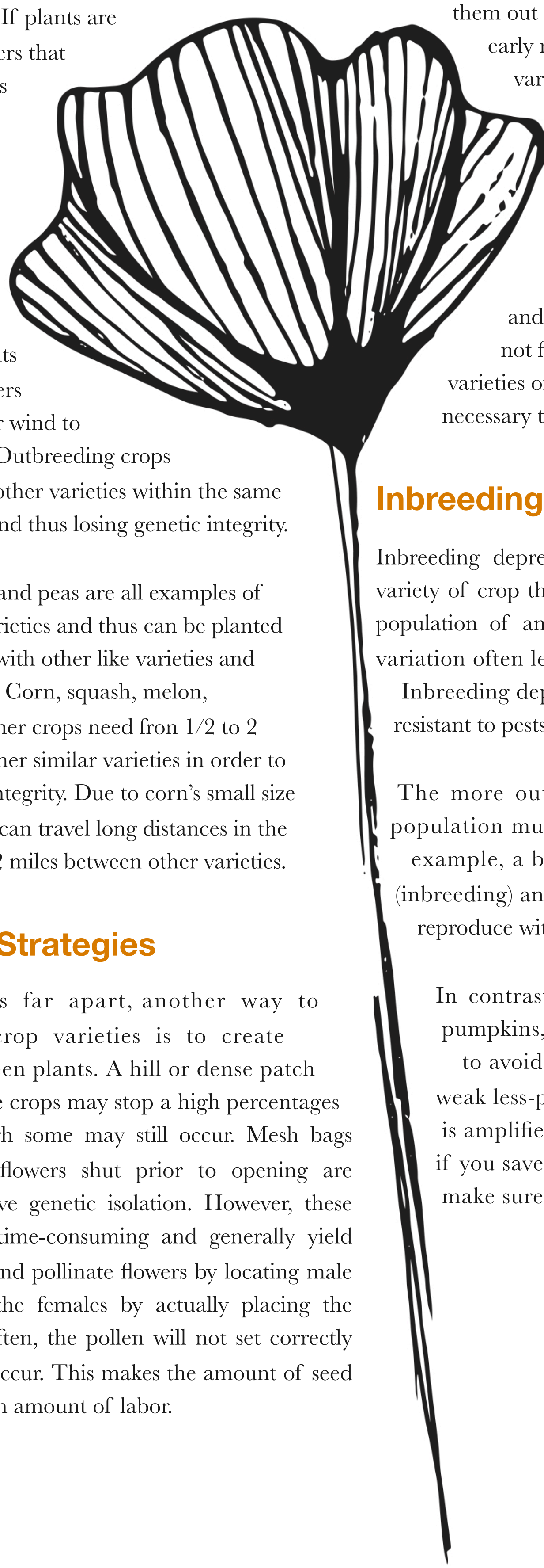
A plant's lifecycle includes germination, vegetating, flowering, sometimes fruiting and then the release of seeds. Most agricultural crops are annuals or biennials and it is essential to know the lifespan of your crop to save seeds. Biennial crops will take two years to die and make viable seeds while annual crops only take one year.

How long it takes for a seed to become viable depends on the plant species. For instance, lettuce seed takes only a few weeks to mature once they have emerged from flower pods. Beans take 4-5 weeks to become mature after the plants are entirely dry and dead. The same goes for squash: the plants must die completely, leaving large hard squashes. The seeds then continue to mature within the squash for another month (ideally at room temperature) before they are mature.

Always let the plants live and complete their lifecycle by dying and releasing seeds. One method to tell if seeds are ready to be harvested is if they fall off the plant easily. For instance, if you shake lettuce seed pods into a bag only the mature (and thus the most viable) seeds will come loose.

## Genetic Integrity

Plants can be either inbreeding or outbreeding and anywhere in between.If plants are inbreeding they have flowers that are synoecious (i.e., flowers have both stamens and pistils) and can thus self-pollinate. These plants can be planted near other varieties of the same crop and maintain genetic integrity. In contrast, outbreeding plants have unisexual, male flowers that rely on insects and/or wind to pollinate female flowers. Outbreeding crops must be planted far from other varieties within the same species to avoid crossing and thus losing genetic integrity.



Tomatoes, beans, lettuce, and peas are all examples of highly inbreeding crop varieties and thus can be planted in the same small garden with other like varieties and maintain genetic integrity. Corn, squash, melon, Swiss chard, and many other crops need fron 1/2 to 2 miles of space between other similar varieties in order to isolate plants for genetic integrity. Due to corn's small size of pollen granules (which can travel long distances in the wind) corn needs at least 2 miles between other varieties.

## Other Isolation Strategies

Besides placing plants far apart, another way to isolate interbreeding crop varieties is to create structural barriers between plants. A hill or dense patch of vegetation between the crops may stop a high percentages of interbreeding, although some may still occur. Mesh bags over flowers or taping flowers shut prior to opening are methods that can preserve genetic isolation. However, these methods are expensive, time-consuming and generally yield fewer seeds. One must hand pollinate flowers by locating male flowers and pollinating the females by actually placing the stamens on the pistils. Often, the pollen will not set correctly and fertilization will not occur. This makes the amount of seed set smaller despite the high amount of labor.

Another way to isolate interbreeding plant varieties is to grow them out at different times. For instance if you grow an early maturing variety of corn and a late maturing variety of corn you could plant them at the same time. The early maturing variety will flower earlier and develop ears and no longer produce viable pollen by the time the late- maturing variety is beginning to flower. This is a tricky practice because you must know the varieties extremely well and keep an eye on them to make sure they do not flower at the same time. When isolating varieties of the same species in this way it often necessary to stagger planting times.

## Inbreeding Depression

Inbreeding depression is loss of genetic variation within a variety of crop that occurs when seeds are saved from a small population of an out-breeding crop. Such a loss of genetic variation often leads to poor yields and a lack of resilience. Inbreeding depression will make the next generations less resistant to pests and disease.

The more outbreeding a crop is, the larger the crop population must be to avoid inbreeding depression. For example, a bean or a tomato plant is self-pollinating (inbreeding) and thus only needs a few plants to effectively reproduce without facing inbreeding depression.

In contrast, outbreeding plants like brassicas, corn, pumpkins, etc. must have high crop populations to avoid inbreeding depression and thus creating, weak less-productive offspring. Inbreeding depression is amplified if it occurs over multiple generations, so if you save seed from a small outbreeding population make sure to note this for following seasons..

**"outbreeding plants have unisexual, male flowers that rely on insects and/or wind to pollinate female flowers."**

## Rogueing

Farmers and gardeners alike aim to save seed from the most resilient and productive plants, thus selecting for the optimal genetic qualities that they would like to save for future seasons. Therefore, plants that have undesirable traits must be destroyed before they flower and reproduce. If you notice a plant that is stunted, ravaged by insects or disease or looks like a hybrid: pull the plant out of the ground. It is essential to search your farm or garden 2-3 times during the season to eradicate any sub-par plants from flowering and thus reproducing. Remember to consider different sun exposures, soil types and other variables that might affect plant growth and make it look like a “rogue plant.”

## Dry Seed

Dry seed sets in pods that have little moisture. It is extremely important that dry seed sets do not get wet. A rain prior to harvesting dry seed can decrease the viability of the seeds and cause mold issues. Dry seeded crops include beans, carrots, beets, Swiss chard, arugula, spinach, lettuce, corn, peas, mustard, etc.

> "the fermentation process imitates a tomato or cucumber decaying in nature"

Do not wait too long to harvest dry seed because much of the seed will be lost if pods open and the plant begins to release its seed set. When harvesting dry seeds, use bags and tarps to make sure seeds do not fall in your field or garden. This helps avoid seed loss and future weeds. With bean seeds, pull plants onto tarps and walk on the plants to break up chaff and plant material from the beans. This can serve as the first round of cleaning the seed.

## Wet Seed

Wet seed sets are encased inside of fruit and thus are protected from many environmental conditions including heat, sunshine, and rain. Pumpkins, squash, gourds, melons, eggplant, cucumber, peppers and tomatoes are all crops that produce wet seed on various scales.

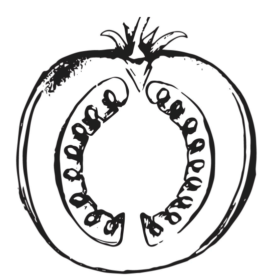
Depending on the crop and how much residue adheres to the seed when the seeds are harvested, some “wet seed” only needs to be dried after harvest; other wet seeds need to be dipped in water and scrubbed. In addition, tomato and cucumber seeds have a gel coat that prevents germination and therefore must be fermented (see below). Once wet seed has been cleaned or fermented, dry in a cool aerated location on a non-stick surface.

> "The more outbreeding a crop is, the larger the crop population must be to avoid inbreeding depression."

## Fermentation

The fermentation process imitates a tomato or cucumber decaying in nature. To save tomato and cucumber seeds, scoop the pulpy seeds into an open jar. Add water (no more than 25% full) to the pulpy solution and stir. Stir the solution 2-3 times a day so that the pulpy seeds ferment evenly. Depending on the ambient temperature the process should take 2-3 days and is complete when a white layer of mold covers the top of the solution.

To separate the seeds from the fermented pulpy solution, add water to the jar. Stir vigorously to break up the pulp and seeds and wait 5 minutes. The heavier seed will settle on the bottom of the jar. Pour the pulp and other floating material out of the jar and carefully collect the fermented seeds to dry. You may have to repeat this process to break up all of the pulp and residue from the seeds.



# Seed Care Recommendations

## Drying Seed

When you harvest seed they need to be thoroughly dried regardless if they are wet or dry seeds. Place seeds in a cool dark place that is open to fresh air. If you are located by the coast or in places with high humidity, make sure seeds are not exposed to outdoor air.

## Cleaning Seed

Once seeds are dry, the plant matter that dried with the seed will be light and brittle. Carefully crush any residual seed pods in your hands or in a bag to dislodge any remaining seed pods and to remove chaff.
For processing large quantities of seeds it is useful to have a "seed threshing machine" that can be calibrated for different seed sizes and can quickly and efficiently clean seeds. However, for small quantities the best method for saving seed involves putting the dried seeds and plant material through a series of screens as a fan blows the lighter chaff away. The screens effectively remove the large chaff particles while the fan blows the smaller particles away. Repeat this process as needed and eventually you will have clean seeds.

## Storing Seed

1. Keep seeds in the dark. The less light a seed is exposed to, the more likely that seed is to germinate when you actually plant it.
2. Keep seeds dry. Moisture causes molding and disease so make sure you store seeds without any moisture.
3. Keep seeds frozen or as cold as possible.

The colder you keep the seeds the longer they maintain their viability.
Every seed has a unique lifespan that ranges from only 1 year to roughly 8 years. Such lifespans should be viewed as a guideline rather than a definitive threshold. Seeds will gradually lose their viability over time if they are not planted. However, old seeds will sometimes still grow despite an extremely low germination rate. If you come across old, rare seeds to not disregard them!

## Record Keeping

If you save seeds, make sure you record information about: what variety, where the plants were grown, and the date that the seeds were saved.
The more information you record the better. If you can, record how many plants were grown for seed, estimate how many seeds were harvested and note any environmental conditions that the plants/seeds experienced.

## Donations

The Demeter Seed Library at UC Santa Cruz is actively working to collect seeds to preserve genetic diversity in our local agroecosystems and create an autonomous food system in the Santa Cruz community. Please help our cause by donating seeds to CASFS (Demeter Seed Project), 1156 High Street, Santa Cruz, CA 95064. Please include information on the variety of seed, when they were grown out and where they were grown out! Thanks for helping our cause!

## References

Coppola, Dan. Bridging the gap between science and law. GMO Litigation. Innovative Science Solutions, ISS. (2013) http://www.innovativescience.net/blog/bid/96832/GMO-Litigation-A-very-real-threat-but- empty-science (February 6, 2014).

Cummins, R. & Paul, K. GMO and the Corporate Patenting of Living Organisms: Monsanto's Patents on Life. Centre for Research on Globalization. (May 25, 2013). *http://www.globalresearch.ca/gmo-and-the-*corporate-patenting-of-living-organisms-monsantos-patents-on-life/5324781 (February 20, 2014)

Mintz, S., & McNeil, S. (2013). The Irish Potato Famine. Digital History. Retrieved (February 5, 2014) from

http://www.digitalhistory.uh.edu/historyonline/Irish_potato_famine.cfm

Secretariat of the Convention on Biological Diversity (SCBD). United Nations Environmental Programme. http://www.cbd.int/agro/whatstheproblem.shtml. (February 5, 2014)

Understanding Evolution. 2014. University of California Museum of Paleontology. 22 August 2008 <http://evolution.berkeley.edu/ >.

# Appendix

| | FAMILY, GENUS, SPECIES | POLLINATION | ISOLATION DISTANCE | # OF PLANTS | SEED LIFE | MISCELLANEOUS INFORMATION |
|---|---|---|---|---|---|---|
| **Annual Vegetables** | | | | | | |
| **Arugula** | Brassicaceae (*Eruca sativa*) | Insect | 1/2 mi. | 40 | 5 yrs. | Easy outcrosser for beginners |
| **Bean** | Fabaceae (*Phaseolus vulgaris*) | Self | 20 ft. | 10 | 4 yrs. | Good for beginners |
| **Bean, Fava** | Fabaceae (*Vicia faba*) | Self | 50 ft. | 20 | 4 yrs. | Primarily selfers, but insects do pollinate |
| **Corn** | Poaceae (*Zea mays*) | Wind | 1–2 mi. | 100 | 6 yrs. | Seed matures 6–8 weeks after eating stage |
| **Cucumber** | Cucurbitaceae (*Cucumis sativus*) | Insect | 1/2 mi. | 10 | 8 yrs. | Male and female flowers |
| **Eggplant** | Solanaceae (*Solanum melongena*) | Self | 50 ft. | 10 | 6 yrs. | Harvest seed from overripe fruit |
| **Lettuce** | Asteraceae (*Latuca sativa*) | Self | 20 ft. | 10 | 3 yrs. | Good for beginners |
| **Melon** | Cucurbitaceae (*Cucumis melo*) | Insect | 1/2 mi. | 10 | 7 yrs. | Does not cross with watermelon |
| **Mustard** | Brassicacae (*Brassica juncea*) | Insect | 1/2 mi. | 40 | 5 yrs. | Will cross with wild species |
| **Pea** | Fabaceae (*Pisum sativum*) | Self | 20 ft. | 25 | 5 yrs. | Good for beginners |
| **Pepper** | Solanaceae (*Capsicum spp*) | Self | 100 ft. | 10 | 4 yrs. | Primarily selfers, but insects do pollinate |
| **Pumpkin** | Cucurbitaceae (*Cucurbita pepo*) | Insect | 1/2 mi. | 10 | 7 yrs. | Male and female flowers |
| **Radish** | Brassicaceae (*Rapnanus sativas*) | Insect | 1/2 mi. | 50 | 5 yrs. | Can cross with wild radishes |
| **Spinach** | Amaranthaceae (*Spinacia oleracea*) | Wind | 2 mi. | 50 | 4 yrs. | Male and female plants |
| **Squash** | Cucurbitaceae (*Cucubita spp*) | Insect | 1/2 mi. | 10 | 7 yrs. | Cross only within species |
| **Tomato** | Solanaceae (*Lycopersicon spp*) | Self | 10 ft. | 10 | 5 yrs. | Good for beginners |
| **Watermelon** | Cucurbitaceae (*Citrullus lanatus*) | Insect | 1/2 mi. | 10 | 6 yrs. | Does not cross with other melon types |
| **Biennial Vegetables** | | | | | | |
| **Beet** | Amaranthaceae (*Beta vulgaris*) | Wind | 1 mi. | 30 | 6 yrs. | Crosses with chard |
| **Broccoli** | Brassicaceae (*Brassica oleracea*) | Insect | 1/2 mi. | 40 | 5 yrs. | Crosses with all oleraceas |
| **Brussels Sprout** | Brassicaceae (*Brassica oleracea*) | Insect | 1/2 mi. | 40 | 5 yrs. | Crosses with all oleraceas |
| **Cabbage** | Brassicaceae (*Brassica oleracea*) | Insect | 1/2 mi. | 40 | 5 yrs. | Crosses with all oleraceas |
| **Cauliflower** | Brassicaceae (*Brassica oleracea*) | Insect | 1/2 mi. | 40 | 5 yrs. | Crosses with all oleraceas |
| **Carrot** | Apiaceae (*Daucus carota*) | Insect | 1 mi. | 60 | 3 yrs. | Crosses with Queen Anne's Lace |
| **Celery, Celeriac** | Apiaceae (*Apium graveolens*) | Insect | 1/2 mi. | 30 | 5 yrs. | Difficult to overwinter |
| **Kale** | Brassicaceae (*Brassica napus*) | Insect | 1/2 mi. | 40 | 5 yrs. | Russian and Siberian varieties |
| **Kale** | Brassicaceae (*Brassica oleracea*) | Insect | 1/2 mi. | 40 | 5 yrs. | Scotch and Tuscan varieties |
| **Kohlrabi** | Brassicaceae (*Brassica oleracea*) | Insect | 1/2 mi. | 40 | 5 yrs. | Crosses with all oleraceas |
| **Leek** | Amaryllidaceae (*Allium ampeloprasum*) | Insect | 1 mi. | 20 | 2 yrs. | Seed tightly encased in seed head |
| **Onion** | Amaryllidaceae (*Allium cepa*) | Insect | 1 mi. | 50 | 2 yrs. | Very short seed life |
| **Parsley** | Apiaceae (*Petroselinum crispum*) | Insect | 1 mi. | 30 | 5 yrs. | Seed heads shatter easily |
| **Parsnip** | Apiaceae (*Pastinaca sativa*) | Insect | 1 mi. | 20 | 1 yr. | Extremely short seed life |
| **Rutabaga** | Brassicaceae (*Brassica napus*) | Insect | 1/2 mi. | 40 | 5 yrs. | Crosses with some Russian kales |
| **Swiss Chard** | Amaranthaceae (*Beta vulgaris*) | Wind | 1 mi. | 30 | 6 yrs. | Crosses with beets |
| **Turnip** | Brassicaceae (*Brassica rapa*) | Insect | 1/2 mi. | 40 | 5 yrs. | Crosses with broccoli raab |

**Source: seedmatters.org**