

Squash and pumpkins

There are a number of species that are difficult to tell apart. Each will cross within species but not between species. There's no separate pumpkin species or family; pumpkin is a label used on squashes of certain shape and color.

- **curcubito pepo** (c:pepo) - summer squashes, crookneck and patipan, zucchini, acorn squash, spaghetti squash, hull-less pumpkin, some other pumpkins (including the very large ones), some smaller gourds such as nest egg gourd.
- **cmoschata** - Butternut, some pumpkins, some asian squash/pumpkins, other squashes
- **cmaxima** - Hubbard, Buttercup, Turban, Potimarron, some pumpkins
- There are other species that are less common, including **c. mixta** (cushaws and others). Large gourds are another separate species.

For all the squashes:

- Long lived seed, 5+ years
- Save seed from ripe fruit; for zucchini/summer squash this means they are far past the edible stage.
- Plants have separate male and female flowers, insect pollinated.
- Female flower can be pollinated by male flower from same plant but prefer a different plant. Very likely to cross; separate very widely, grow only one of each species, or hand pollinate.
- Easy to hand pollinate
- Can possibly save from 1 plant, minimum 6 recommended or 12-20 preferred.

Carrots

- Biennial, save seed second year. Don't save seed from any that flower the same year.
- Will cross with wild Queen Anne's Lace; ensure none is growing nearby, check for and remove white (accidentally crossed) roots.
- Outbreeding, insect pollinated, crosses readily
- Subject to inbreeding depression. Need 20+ plants for genetic diversity, 50 recommended.

Melons

Watermelons are a separate species and will not cross with cantaloupes and other common melons.

- Save seed from ripe fruit
- Plants have separate male and female flowers, insect pollinated.
- Female flower can be pollinated by male flower from same plant but prefers a different plant. Very likely to cross; separate very widely, grow only one variety, or hand pollinate.
- Can save from 1 plant (although more is better)

Cucumbers

- Long lived seed, 5+ years
- Plants have separate male and female flowers, insect pollinated.
- Allow fruit to get large, yellow, soft; squeeze out seeds and juice and let ferment
- Female flower can be pollinated by male flower from same plant but prefers a different plant. Very likely to cross; separate very widely, grow only one variety, or hand pollinate.
- Can save from 1 plant (although more is better)

Onions

Will cross with shallots, but not with leeks or chives.

- Short lived seed, 2 years or less
- Biennial, save seed second year. Don't save seed from any that flower the same year, or onions with double cores.
- Outbreeding, insect pollinated, will cross.
- Subject to inbreeding depression. Need 20+ plants for genetic diversity, 50 recommended.

Corn

- Short lived seed, 2 years.
- Wind pollinated, readily crosses.
- Crosses affect the current crop, not just next years. For Some hybrids, the crop is badly affected by current year cross pollination.
- Severely subject to inbreeding depression. need minimum 100 plants for genetic diversity, 200 or more recommended.

Other Tips

- Remember to save seed from the best plants; healthiest, fastest growth, largest crop, most true to type.
- Be aware of what your neighbors are growing; in particular for vegetables that flower as part of normal production (squash, for example)
- For root crops, it's recommended to dig them up and inspect, then replant the best ones for the seed crop.
- For plants subject to inbreeding depression, plant in close blocks to allow as much cross-pollination as possible. Bees moving down a single long row would only pollinate adjacent plants.
- If you are saving seed for a year or two, then restarting with commercial seed, genetic diversity isn't a significant issue.
- Don't forget to take notes and label the seeds and their history.

Seed Saving

Seed saving is easy! Plants want to produce seed, and the seed wants to grow; and nearly everything you're likely to get will be edible. It gets interesting when you want to get specific repeatable results; and when you want to consider long term health of a variety. But what makes seed saving seem so overwhelming is that every vegetable variety is different.

The Processes - Skills

1. Starting seed to grow into plants

Before you start worrying about saving seed, you should be able to start plants from seed. This is a prerequisite skill for the seed saver!

2. Managing pollination and controlling cross-pollination

For regular gardening, for food production, this is only a consideration for corn, in which accidental cross pollination shows up in this year's crop. And some plants won't set fruit if there is only one; tomatillos, for example. But for most vegetables, any cross pollinating only matters when you are saving seeds.

To produce seed, pollen from the male flower or flower part, must get to the female flower or flower part. This can be done by proximity, for vegetables that can self-pollinate within the same individual flower (such as tomatoes and peas). Or it may be insects (ants and flies as well as bees - even cucumber beetles) that move pollen from flower to flower, as for squash. A few vegetables are wind-pollinated. Insects may also visit self-pollinating flowers (again, like tomatoes and peas) and cause unexpected crossing; experts disagree on the risks of this. It's apparently affected by the number of insect pollinators in your particular garden, how it is physically arranged, wind, climate, etc.

Avoiding unwanted pollination is done by:

- Isolation, so the wind or insects are unlikely to bring pollen that far. Reference books list very large isolation distances - a mile! This may be critical for commercial seed, or to preserve the purity of a special heirloom; but for your own production, where you can tolerate or remove off-types, it's less important.
- Physical barriers - insect-proof cages or bags. For varieties that need insect cross-pollination this can get tricky; there are many complex ways of hand-pollinating, schemes of caging so insects can get to some plants and not others, etc. Consult the reference books for these details.
- Separation in time, making sure that one variety is done producing pollen before the next one has any flowers.

3. Getting plant to stage where it has good seeds

If you leave your vegetables alone, eventually they get to the stage where they produce seed.

- With fruit and pod type vegetables, generally you let the fruit get very ripe - possible too ripe to eat, which may impact your edible crop. Remove the seed and that's it.
- For leaf-type plants, they generally will flower, either the first summer or the second summer. They put up one or more seed stalks with lots of flowers, followed by seed.
- Root vegetables, including some brassicas and chard, store energy the first year in their root, so early the second year they put up flower stalks. These are more effort, since you need to save the plant over the winter. In the Rogue Valley the winters are mild enough that most biennials will overwinter in the garden without any special care.

4. Processing seed, and storing until the following season

Usually all that's required is to get the seed dry. Seed must be totally dry to store; otherwise it will rot, sprout or get moldy. A few vegetables, like tomatoes and cucumbers, are usually fermented before drying - this increases their ability to sprout and gets rid of some diseases. Imagine how in nature the ripe fruit falls and decays, this is the same system. But usually, just get the seed very dry, and store in a cool place or freezer until the next year. Do not dry seed in the oven or a hot dehydrator or anywhere it may overheat, which will kill the seeds.

Some types of seed will remain viable for many years, but other seed loses its ability to sprout after a year or so, even under the best conditions.

The Science - Knowledge

1. Hybrid, open pollinated and heirloom

Commercial seed is either **hybrid (F1)** or **open-pollinated**. Hybrids are crosses between two distinct and different varieties; the first generation is consistent but later ones may vary greatly. Sometimes the results of saving seed from hybrids are good, other times very disappointing. **Open pollinated** varieties will produce seed that will in turn produce new plants just like themselves. When seed saving, it's better to start with open-pollinated seeds. **Heirlooms** are open pollinated varieties that have been around by name for a long time, usually 50 years.

There's nothing inherently wrong with hybrids - it's completely different than GMO (genetically modified organisms). You could produce your own hybrid seed at home, and there are commercial organic hybrids. Hybrids are a problem when we're dependent on them and therefore on seed companies.

2. Genetic diversity

How many plants should you save seed from? This is a big question without easy answers.

Vegetables are either inbreeding or outbreeding. Inbreeding vegetables pollinate themselves. For these vegetables, you only "need" one plant to save seed. However, this means there's risk:

- With each generation that you save seed, you lose genetic diversity: one plant can only pass down one-half the genes of each parent. The other genes aren't available later to adapt to changing conditions.
- A random mutation could show up - possibly one that's not immediately obvious - and spoil your entire gene pool (all your seed).

Outbreeding plants need another plant of the same variety to pollinate them. Outbreeding plants are subject to a varying degree to **inbreeding depression**. This means that if the population from which you are saving plants is too small, after some generations of saving seed, your yields are reduced, plants may die easily, germination may be bad, and strange recessive traits may show up. By this time it's too late to fix the problem, you need to find new seed to mix in.

If you are saving seed for just a few generations, and then willing and able to start over with fresh commercial seed, this isn't so much of an issue. The problem of inbreeding only lies in perpetual reproduction.

For plants subject to inbreeding depression, it's recommended to save seed from 40 plants - planted closely in blocks so that they all cross pollinate each other. To retain full genetic diversity, more would be needed: "Seed to Seed" cites a general rule of 100 outbreeders. But you can save seeds from just 20 plants, or even 10, being aware of the risks.

Corn is a special case, since it's very sensitive to inbreeding depression. 100 plants is considered the bare minimum, 200 or more is recommended.

3. Selection, evolution and responsibility as curator

When you select individual plants to use to produce seed, you are selecting the traits that this plant will pass on. Select the best plant for reproduction! If you select the first spinach to flower, or the last beet to get to full size, the next generation is likely to bolt quickly, or grow slowly. Selecting the healthiest, best adapted plants over several generations will adapt the variety to your specific growing conditions.

To make sure the vegetable seed is the highest quality, start extras of the seed crop, and "rogue" (yank out) the least desirable - off types, the ones that grow slowly, are smaller, or produce less fruit or fewer leaves. Eat them! It's hard to do this, but this is the responsibility we take on when we save seeds.

4. References

Seed to Seed: Seed Saving and Growing Techniques for Vegetable Gardeners, Suzanne Ashworth and Kent Whealy

Breed Your Own Vegetable Varieties: The Gardener's & Farmer's Guide to Plant Breeding & Seed Saving by Carol Deppe

Seed Saver's Exchange: <http://www.seedsavers.org>

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Details for Selected Vegetables

Lettuce

- Allow to bolt and flower; collect seeds as they are ready to fall from plant.
- Inbreeding, self-pollinating; possible but not likely to cross; separate slightly
- No inbreeding depression, can save from one plant (although more is better)

Beans and Peas

Peas, beans, soybeans, chickpeas and fava beans are in the same family, but within each species may cross, so for example snow, snap and shell peas may cross with each other but not with beans.

- Long lived seed
- Let pods dry on vine
- Inbreeding, self-pollinating; may insect pollinate, possible to cross if you have insects; separate slightly.
- No inbreeding depression, can save from one plant (although more is better)

Tomatoes

- Long lived seed
- Allow fruit to get very ripe, squeeze out seeds and let the juice/seeds ferment, then clean and dry.
- Inbreeding, self pollinating, possible but not likely to cross, separate slightly or bag.
- A few specific varieties have different flower shape, and are much more likely to cross.
- No inbreeding depression, can save from one plant (although more is better)

Peppers

- Allow fruit to get very ripe, remove seeds
- Self or cross pollinating, very likely to cross by insect visits, separate a good distance or bag
- "Hot" is dominant; the results when sweet pepper flowers get pollen from hot peppers will be hot.
- No inbreeding depression, can save from one plant (although more is better)

Beets and Chard

- Long lived seed
- Biennial, will flower and set seed the second year; don't save seed from any that flower the same year.
- Allow to flower, set seed, dry on plant
- Outbreeding, wind pollinated, will cross with other beets and chards
- Need minimum 6 plants, ideally 20+ recommended for genetic diversity

Arugula

- Annual, will flower when it gets warm, don't harvest first plants to flower.
- Allow to flower, set seed pods, pods dry on plant
- Outbreeding, insect pollinated, likely to cross with other arugulas.
- Need minimum 6 plants, better 20+, 40 is recommended for genetic diversity

Brassica oleracea - broccoli, cabbage, cauliflower, kale, collards, brussel sprouts, gai-lan and kohlrabi

These are in the same family, will cross with each other but don't cross with other brassicas.

Brassica rapa - turnips, broccoli raab, chinese cabbage/mustard, bok choy

These are in the same family, will cross with each other but don't cross with other brassicas.

For all Brassica:

- Leaf and root types are biennials and will flower second year; others such as broccoli, cauliflower, raab, etc., for which the edible part includes the flower, are annuals. For biennials, don't save seed from plants that flower the first year.
- Allow to flower, set seed pods, pods dry on plant
- Outbreeding, insect pollinated, likely to cross within species.
- Subject to inbreeding depression. Need a minimum of 6 plants, better 20+, 40 is recommended, for genetic diversity

Radish

- Biennial, will flower second year. Use caution in saving seed of early plantings that flower the same year, to avoid encouraging early bolting trait.
- Allow to flower, set seed pods, pods dry on plant
- Outbreeding, insect pollinated, likely to cross with other radishes but not other brassicas.
- Subject to inbreeding depression. Need a minimum of 6 plants, better 20+, 40 is recommended for genetic diversity.

Spinach

- Allow to bolt and flower; don't harvest first plants to bolt
- Outbreeding, with separate male and female plants
- Wind pollinated, very likely to cross with other flowering spinaches.
- Need at least 8 plants to ensure male/female ratio and genetic diversity