Ashworth, S.
Seed to Seed: Seed Saving and Growing Techniques for Vegetable Gardeners, 2nd Edition. Seed Savers Exchange, Inc., 2002. (ISBN 1-882424-58-1)

NOTE: Not all of the text has been summarised. In Section II: Major Vegetable Families, the specifics for the various family members has not been summarised; specifics for a couple have been included and this may expand as I attempt seed saving in a wider range of plants (listed but no specifics). Section III: Other Families With Vegetable Members has not been summarised at all.

Introduction

-most home gardens that use seeds for their vegetable crops depend on commercial seeds; only a minority save seeds from their garden harvest
-little published writing is available to help guide this process (thus the motivation for this book)
-contradictory literature tends to be the result of site-specific environmental factors (especially crop sizes and insect population)
-some of the isolation distances given in this text come from commercial seed producers whose focus is on much larger production and thus not relevant to home gardeners
-for site-specific recommendations, savers must engage in their own research
-seven major regions have been used within this text

Section 1: Saving Vegetable Seeds

-seeds have come down through history via our ancestors selecting seeds from the best plants of their harvest to replact

Saving Our Garden Heritage

-a large variety of crops has been created by immigrants from all over bringing seeds from their homeland favourites

Heirloom Varieties: An Endangered Tradition

-selecting seeds from the best plants and using them year-after-year in the same region may help lead to varieties resistant to local diseases and insects, as well as adapted to regional climate and soil
-these heirloom varieties are well-suited to one's areas but are being lost as fewer people practise food gardening

Rapid Losses Among Commercial Non-Hybrid Varieties

-while the commercial seeds available widely originated with heirloom varieties, the diversity these had have been lost over time, especially due to more profitable hybrids and patented varieties
-commercial seeds tend towards more generalised varieties that can grown in various regions but are not specialised for local climates or pests and diseases

Hybrid Varieties Gain Dominance

-the shift to hybrid varieties has had the greatest negative impact on crop diversity
-their seeds are worthless to save for the most part as they tend to be infertile or revert to an unknown parent variety
-heirloom/open-pollinated varieties faithfully reproduce their parental type (if not cross-pollinated with similar varieties nearby)
-for self-pollinating crops, the differences between hybrid and heirloom seeds is less drastic as self-pollinating plants are naturally 'inbred'
-hybrid varieties tend to be bred to facilitate commercial processes such as mechanical harvesting, simultaneous ripening, long-distance shipping uniform characteristics, etc.
-old varieties are threatened due to their unsuitability for industrial agriculture

Passing Heirlooms on to Others

-while growing heirloom seeds and saving them for one's garden is important, passing them on to others is also vital and the sharing of knowledge
-if there is interest, sell the seeds (and/or produce)

Gardeners as Stewards

-the saving of seeds has been a key to successful food production for thousands of years
-it must continue or risk the extinction of many crop varieties

Botanical Classifications

-vegetables are discussed in terms of their botanical family, genus, and species
-species names are important to preservation of specific varieties
-plant classification has been a vital development as people travelled, traded, and migrated
-Charles Linnaeus (1727) introduced the binomial nomenclature system
-families are divided into genera (first Latin name) that share more morphological similarities
-genera are further divided into species (second Latin name), whose members are able to interbreed
-species can contain a variety of cultivars (cultivated varieties) that can cross
-taxonomic classifications within this book use the Hortus Third System (that focuses upon Canada, Mexico, and the U.S.)

Pollination and Flower Structure

-knowledge of plant reproduction is important for seed savers
-most plants contain both the male and female organs
-the male organ, stamen, carries the pollen-producing anther at the end of a filament
-when ready/ripe, the anther opens to expose pollen grains
-the female organ, pistil, consists of a stigma, style, and ovary
-the stigma receives pollen and can vary in size and shape
-when a pollen grain touches a receptive stigma, a pollen tube forms down the style to the ovary where it fertilises ovules
-the ovary develops into the fruit/seed pod while the fertilised ovules from the seeds
-if pollen from a different variety comes into contact with the stigma, a not-true-to-type seed will result
-monoecious plants produce male and female flowers on the same plant (e.g., squash), whereas dioecious plants have separate male and female plants (e.g., spinach)
-while cross-pollinated plants will produce fruit that doesn't appear out of place, the seeds will not be true-to-type as it will hold genetic info from both parents and the subsequent fruit could display combined characteristics
-this cross could eventually stabilise (6-12 generations) but to avoid such experiments, cross-pollination risk needs to be minimised

Self-Pollinated Plants

-pollination in 'perfect' flowers (containing both male and female components) usually occurs without need of pollinators or wind
-some self-pollinating plants may still be cross-pollinated and require interventions to avoid this (e.g., peppers)
-some perfect flowers cannot self-pollinate

Insect-Pollinated Plants

-plants with imperfect flowers (male and female flowers on same plant; e.g., squash, cucumbers) tend to require insect pollinators
-to maintain seed purity, such plants should be isolated from different varieties of the same species
-honeybees are the most efficient pollinators with their dense body hairs accumulating pollen that they then comb into pellets and store in pollen baskets on their rear legs
-there are a species of wild bees known as squash bees that have been known to forage up to 7 miles although most bees remain within ¼ mile of their hive

-bumblebees, sweat bees, and wild solitary bees are random pollinators whereas honeybees tend to focus on particular flower colours/types
-moths and butterflies are poor pollinators as they are covered with scales rather than hairs
-wasps are also not effective pollinators, whereas flies can be when they seek nectar

Wind-Pollinated Plants

-pollen can travel for long distances via the wind
-many plants depend on the wind for pollination (e.g., trees, grasses, grains)
-wind-pollinated veggies include corn and spinach

Maintaining Varietal Purity

-our vast array of crop varieties are the result of thousands of years of selection and movement across the planet into many different ecological niches
-maintaining varietal purity is a constant challenge

Isolation Distances

-isolating a variety can maintain purity by eliminating insect and wind-borne pollen
-this is difficult when nearby vegetable gardens exist; this situation will require bagging, caging, and hand pollination
-the isolation distances commonly proved are for commercial producers and appear excessive for home gardeners
-actual distances are site specific and depend upon plant population size, alternate pollen sources, pollinator population density, and geographic barriers
-experimentation is necessary to determine distances required for a home garden

Time Isolation

-some plants can be isolated over time by polatning one variety as early as possible
-when the early crop begins to flower, plant the second variety
-this will work if the first crop has finished setting its seeds before the second crop flowers
-plants that show success in this include: corn, sunflowers, and lettuce (obviously, maturity dates are important to know)
-weather variability can impact plant growth and this process

Mechanical Isolation

-using a constructed physical barrier may be needed to prevent unwanted cross pollination
-the barrier needed depends on the plant

Bagging Techniques

-placing a bag over the flower is one method and usually used to prevent cross pollination of self-pollinating plants
-bagging individual flowers or a cluster if very effective/efficient if caging is not possible and only a small number of seeds needed
-spun polyester cloth is commonly used
-any bags need to be tied securely around the stem to keep insects out; cotton can be used to protect the stem
-this technique doesn't work for extremely small pollen grains (e.g., spinach) carried by wind
-paper bags can also be used but are problematic in rain

Caging Techniques

-protecting some self-pollinating plants can be accomplished by a screened cage
-window screening or spun polyester cloth works to keep insects from cross pollinating plants

Alternate Day Caging

-two or more varieties that are flowering simultaneously can be protected by cages used on alternate days
-insects will pollinate the uncaged plants one day and have no access the next, when the previously caged plants are available

-this method may reduce seed production but plants may compensate for this by producing flowers over a longer time frame
-cages are needed for each group of plants with one being removed each morning then replaced in the evening; the next morning the other is removed then replaced; this is continued until all flowers are finished or until enough seed pods have formed (and cages left on until all plants have finished flowering)
-this would work great for six kale and six cabbage plants
-the number of varieties with this method can be expanded up to four, removing/replacing cages on a four-day rotation

Caging With Introduced Pollinators

-using trapped flies or newly emerged bees is another method sometimes used but requires much larger cages (typically the size of a small greenhouse)
-queenless hives (nucs) with ready-to-hatch bees placed in the caged area is the most effective approach with this method

Hand-Pollinating Techniques

-pollinating plants by hand is another common approach to ensure the production of pure seeds
-it is used for plants that depend upon insects but occasionally for wind-assisted pollination
-the idea is to transfer uncontaminated pollen from a male flower onto the receptive female stigma that has been protected
-after the pollination by hand, the female flower must be protected from cross pollination

Selecting Desirable Characteristics

-plants and their seeds are changing constantly due to environmental (e.g., drought, disease, pests, etc.) or genetic (e.g., drift, mutations, etc.) factors
-selecting seeds that carry favourable traits is important to continued success
-observing plants throughout the season keeping in mind preferred characteristics such as disease/pest resistance, stockiness, uniformity, drought tolerance, and trueness-to-type; as well as fruit traits such as colour, size, shape, productivity, storability, etc.
-only seeds who show good virility (e.g., ability to germinate rapidly and be resistant to disease) should be saved
-characteristics specific to one's climate is also an important consideration
-for example, later-bolting lettuce plant seeds would be preferable to earlier ones to provide a longer harvest

Population Size

-maintaining genetic diversity within a population is key to ensuring better adaptation to changing conditions
-this is accomplished by considering the minimum number of plants of the variety you are saving seeds from that need to be planted, and collecting seeds from a variety of plants not just a single plant
-a general rule of thumb is to collect seed from 20 inbreeding (self-pollinating plants) or 100 outbreeding plants; obviously, home gardeners have space limitations where such requirements are impossible to meet
-Carol Deppe in Breed Your Own Vegetable Varieties, suggests that these guidelines aren't as important for home gardeners who are mostly interested in growing fresh seed for their own use in their specific region and climate
-larger plant populations are important if your seeds are for more widespread use
-if a variety is extremely variable, then very large plant populations are important to maintain their variability and some seed from each plant is needed
-self-pollinated plants are an exception as they tend to be inbred with little diversity (e.g., beans)
-another exception would be cucurbits (i.e., squash, melon, cucumbers) that are outbreeding but show minimal inbreeding depression from a small population even when 'self-pollinated' (when hand pollinating these avoid 'selfing')
-corn, however, is very sensitive to small populations and may show negative impacts in a single generation

Reacquiring Genetic Diversity

-seeds from plants with small populations may begin to lose vigour after only a couple of generations due to a lack of genetic diversity
-this diversity can be reacquired by finding seeds of the same variety from a seed savers' exchange and introduce the new plants and subsequently increasing population size grown

Roguing For Trueness-to-Type

-roguing crops to ensure off-type plants are removed maintain plant purity
-plants whose foliage, colour, and/or flowers are unusual, or show early bolting, etc.
-even small scale seed savers should remove undesirable plants (and thus plant more than desired to begin with) prior to pollination
-off-type plants can be left and harvested for food as long as they are removed prior to flowering/pollination
-biennials can be grown for produce during their first season and off-type ones and removed their second season
-sometimes off-types can't be discovered until fruit forms and this may lead to problems the following season, especially for nearby plants that may have been pollinated by the off-type plant
-keeping track of plant seed for close and far plants, and aware that some may be off-type the next season may allow for those to be eliminated by discarding their seeds

Seed Cleaning Methods

-seeds may be cleaned via wet or dry processing
-for plants, with seeds in a damp fruit/berry, wet processing should be used (e.g., tomato, cucumber, melon)
-dry processing is for seeds within pods/husks that should be left to dry naturally on the plant (e.g., peas, beans, corn, lettuce)

Wet Processing, Fermentation, and Drying

-wet processing involves 3 basic steps: seed removal, washing, drying
-seeds can be removed by cutting large fruit open and scraping them out, or mashing smaller fruit
-some species require the seeds, pulp, and juice to go through fermentation to allow bacteria and/or yeast to destroy seed-borne diseases (water should not be added during this)
-when ready, seeds should be washed by placing then in a container with twice the water of seed/pulp volume and mixed vigorously; viable seeds will sink and the unviable ones float; pour off the water and debris, repeating this process until only viable seeds remain; place seeds in a strainer and rinse under running water; wipe bottom of the strainer to remove excess moisture and then dump the seeds onto a wood, metal screening, glass, or ceramic surface; attempt to dry seeds relatively quickly (warm, wet seeds may germinate or mold) by spreading seeds out and moving them about periodically several times a day–never dry in an oven or in direct sunlight if temperature could get above 95 degrees fahrenheit

Dry Processing

-seeds in pods/husks should be harvested dry and ideally dried in the garden naturally
-if a frost is imminent before the pods can be harvested dry, pull the entire plant and hang it in a spot where it won't freeze to allow pods to dry naturally in a location that won't freeze
-seeds can be separated from their pod via threshing (pods are rubbed, beaten, or flailed; perhaps by placing in a sac)
-winnowing is the process to separate seed from debris and depends upon wind to blow away lighter debris
-it's recommended something be placed under the area wher ethos is being done to catch errant seeds (e.g., sheet)
-a simple method is to pour the material to be separated from one container to another in the presence of wind (constant is best and may be via a fan)
-another method is to use screening of an appropriate size to allow material smaller than seeds to drop through

Hot Water Treatment

-a simple way to help combat some seed-borne disease is to use hot water

-heat water in a saucepan to 50 degrees Celsius; pour some into an electric frypan, leaving the saucepan ⅔ full and then place saucepan in frypan; using a thermometer , regulate saucepan temperature to 50 degrees and continue stirring for appropriate time for seed type: 20 minutes (broccoli, Brussel sprouts, kale chinese cabbage); 25 minutes (eggplant, spinach, turnip); 30 minutes (celery, pepper); 25 minutes at 52 degrees (cauliflower); 30 minutes at 52 degrees (cabbage); 25 minutes at 55 degrees (tomato)
-sieve the seeds and spread out to dry, then store

Seed Cleaning Equipment

-commercial products for seed cleaning can be purchased but can be expensive
-there are public domain designs available free of charge
-constructing your own would be the most cost-effective approach with most material available through one's local hardware store

Seed Storage Techniques

-various containers can be used for collecting and storing seeds (e.g., woven basket, paper bag, cardboard box, plastic tubs/buckets, etc.)

Airtight Storage Containers

-vegetable seeds are best (high vigour: germinates quickly and disease resistant) when left to dry on the plant
-they are best maintained when thoroughly dry and in an airtight container
-high moisture and temperature are the worst things to impact seed vigour (fluctuations in these make it worse); a humid environment is worse than a warm one
-containers should always be airtight
-mason jars may be the best option
-plastic, ziploc bags are not moisture-proof but may be used inside jars

Long-Term Frozen Storage

-seed vigour actually declines before germination is lost
-a 2-4 year rotation that maintains at least 70% germination rates can be achieved if long-term frozen storage is used
-if seeds are dried to around 8% moisture, and placed in an airtight container and frozen then almost all seeds should germinate
-in fact, seeds should last up to 10 times longer than normal
-one test for moisture content is to bend seeds; if they break rather than bend, they are dry enough; for hard-shelled seeds, they will shatter instead of mashing when struck by a hammer on concrete
-to help dry seed, silica gel can be added to a jar (gel beads are blue when dry, pink when moist; and can be reactivated by drying in an over at 200 degrees fahrenheit for 8 hours or about 25 minutes in a microwave in an 8 x 12 inch dish 1 ½ - 2 inches deep)
-place paper seed packs in an airtight jar with equal weight of silica gel; store for 7 days; remove gel and place seed container in a freezer (ideally), or refrigerator, or any cool, dark place where temperature won't fluctuate greatly
-when retrieving seeds to plant, allow jar to sit at room temperature overnight before opening; expose seeds to air for a few days before planting

Overwintering Biennial Plants

-overwintering biennials varies depending on one's climate
-a fall planting may occur in mild climates; an area with slight ground freezing over the winter may only require some mulching for plant protection; for northern regions where the ground freezes solidly, more work is required as plants/roots need to be dug up and stored in a dolc, dark area (ideally a root cellar)
-biennial plant/root storage also requires: containers; paper; clean, dry leaves; water containers; humidity gauge
-a root cellar is a great location as plants/roots won't freeze or dry out (ideal temperature is 32-40 degrees fahrenheit)

-basement storerooms constructed for such purposes is another option (i.e., insulated, passive ventilation, etc.)
-using a garage or shed is possible but they tend to be prone to significant temperature fluctuations
-there are also various types of storage pits that can be used

Germination Testing

-utilising long-term frozen storage is best for seeds with high germination rates
-exposing seeds to moisture and warmth can help test their germination rates
-placing seeds on a square of heavy paper towel sprayed with warm water (25-100 seeds recommended); cover with another piece of moist paper towel; roll the layers up and place in a lightweight plastic bag (e.g., bread bag) with a few holes poked in for air circulation; place in a warm location with relatively constant temperature (e.g., top of refrigerator) around 75 degrees fahrenheit
-seeds should start to germinate in 7-10 days but check daily for moisture
-after 7 days count germinated seeds and remove them; repeat after another 7 days (more weeks if see germination times are longer)
-total number of germinated seeds after 2-4 weeks divided by total seeds laid out gives a germination rate

Record Keeping

-seed growers should maintain accurate records of seed sources and plant characteristics
-a card file system is one approach placing plant types on dividers and variety of seed on cards with information on: plant type; variety name; name and address of source; date obtained; germination rate; storage date; year last grown; special notes; accession number; season observations (e.g., days to maturity, plant height, fruit size, colour, shape, productivity, disease resistance/susceptibility; flavour; storage qualities)
-descriptor lists should also be maintained and contain: botanical and common names, accession numbers/seed source, data source, evaluator name, days to maturity (from seed and/or transplant), days to flower, flower description, fruit colour and dimensions, disease/insect problems,
-photos of flowers, leaves, fruit on 1 inch grid paper is also useful

Supplies For Seed Savers

-text lists a number of companies that provide supplies: Abundant Life Seed Foundation, Johnny's Selected Seeds, Lawson Bag Company, Packaging Aids Corporation, Peaceful Valley Farm Supply; Synthetic Industries; Seed Savers Exchange; Southern Exposure Seed Exchange; Territorial Seed Exchange

Section II: Major Vegetable Families

The Amaryllidaceae Family

-onions, leeks, and garlic are grown worldwide and have been used by humans since before recorded history
-there are more than 400 known species

Family Taxonomy

-sulphur compounds in the leaves and bulbs give the strong odour that is characteristic of alliums
-hollow-round leaves is also common (onions), as are flat leaves at a 45 degree angle (leeks, garlic)
-many are multicentric (multiple underground bulbs)

Pollination Characteristics and Techniques

-contain perfect flowers but do not self-pollinate
-the anthers shed pollen for 3 days prior to style/stigmas being receptive , that are receptive for 6 days
-flowers, however, open over a period of about 30 days so that there is overlap and some stigma/styles are receptive when some anthers are shedding pollen
-files and bees are allium's primary pollinators while wind is not used
-varieties can be isolated via alternate-day caging or rotations of types grown in a given year
-if hand pollinating, it should be done every day for 2-4 weeks; immature flowerheads need to be bagged (with at least 10 flowers done); remove bags each morning (about 9 am to 12 pm); using a camel hair brush

to transfer pollen and rotating through all flowers twice then rebag; bags can be removed for dood once all seeds have set; tag hand-pollinated flowers for identification

General Production and Processing Techniques

-examine all plants whose seeds are to be saved
-remove plants with off-foilage, or that bolt/flower during first season
-save only best true-to-type bulbs
-most common method for growing biennial allium is seed-to-bulb-to-seed method: plant seeds in spring; harvest mature bulbs in fall; store only healthy true-to-type ones to replant in spring that should produce a seed stalk
-in warmer weather climates, seed-to-seed can be done: plant seed in late fall/early fall so plant grows during winter and bolts to seed in spring
-the seed-to-seed method does not allow for bulb roguing so off-types cannot be removed
-let seed heads mature on the stalks but ensure they get harvested as soon as dry
-if climate too humid, cut off stalks and leave to dry in a protected area or food dehydrators around 85-90 degrees fahrenheit
-seeds should fall out of pods fairly easily and then winnowing can help get rid of debris

Text Specifics for: leeks; common onions and multipliers; Japanese bunching onions; garlic and rocambole; common chives; garlic chives

Common Onions and Multipliers

Garlic

The Brassicaceae Family

-there exist more than 350 genera in this family
-plants in this family have been used by humans throughout recorded history

Family Taxonomy

-seedlings of this family look very similar, with their flowers also appearing the same

Pollination Characteristics and Techniques

-seeds are difficult to save since all varieties of a species can cross-pollinate (e.g., Brussel sprouts, kale, broccoli, cabbage, cauliflower, kohlrabi, and collards can all cross)
-while the flowers are perfect, they require insect pollinators and many varieties are self-incompatible (pllent must come from a different plant)
-because of these characteristics, seeds should not be saved from a single plant but several
-the more plants, the greater the chances of pollination
-this is further complicated by a few varieties that do self-pollinate
-varieties need to be isolated by at least ½ mile, caging with introduced pollinators, or alternate-day caging (ideally with spun polyester material)

General Production and Processing Techniques

-save seeds primarily from plants that do well in your region
-avoid those that do not perform well in the sense of poor production, disease/insect resistance, stunted growth, etc.
-while certain damage (e.g., weather, insect) won't affect the genetic makeup, it may impact seed quality/quantity
-seed pods need to be left to mature on plants and hand-harvested due to their fragility
-pods may require protection from birds
-continue to dry harvested pods out of direct sunlight
-pods should open on their own or will require hand opening; some winnowing may be necessary

-seeds don't usually need further processing unless certain diseases are noticed (i.e., black rot, black leg, black leaf spot) and then hot water treatment is recommended
Text Specifics for: rutabaga, Siberian kale, and rape; cabbage; broccoli and cauliflower; kale and collards; Chinese cabbage and Chinese mustard; turnip and broccoli raab; radish; horseradish; wild-flowered mustard; Indian mustard and mustard greens; black mustard; Brussel sprouts; kohlrabi; sea kale; rocket; maca; farden cress; large leaf watercress; common watercress

Broccoli

Kale

The Chenopodiaceae Family
-several varieties have been noted in early writings (e.g., Aristotle) around the world
Family Taxonomy
-this family's members are diverse in their growth habits and seed formation
-some have a number of seeds in a calyx (hard and woody pod) while others in panicles (flower cluster) of individual seeds
Pollination Characteristics and Techniques
-these plants are wind-pollinated with pollen traveling up to five miles
-to keep crops 'pure', isolation is necessary
-one method home gardeners use is to place a support stake in the centre of several plants; plant seed stalks are bent towards the stake then covered with a large, water-resistant paper bag; cotton is used to protect stalks where the bag is pulled tight and taped to form a 'seal'; movement of the bag via wind or occasional shaking is enough to cause pollination of plants
General Production and Processing Techniques
-seeds can be harvested by hand off the plants once they are mature and dry
-if rain is a problem, plants can be pulled and covered to allow final drying
Text Specifics for: garden beet, sugar beet, mangel, and Swiss chard; spinach; mountain spinach (orach); lambs-quarter; good King-Henry; beetberry; quinoa
The Compositae Family
-also known as the salad family, with lettuce being its most widely-grown member
Family Taxonomy
-this is a very large family divided by a few characteristics such as presence of a milky or coloured sap, corolla type, anther and style morphology
-of the 20,000+ species, only a few (11) are viewed as vegetables
Pollination Characteristics and Techniques
-perfect flowers and most are self-compatible but require assistance (insect or mechanical agitation) to get pollen to stigma (only a few are not self-compatible and must attract insects)
-insect pollination provides best chance of seed production
-seed stalks grow up from the centre of plants
-many home gardeners saving seeds isolate or hand-pollinate varieties
-cross-pollination can be avoided via caging, alternate-day caging, and caging with introduced pollinators
Plant Selection
-plants should be observed during their growth to ensure they are true-to-type, removing plants that differ in colour, size, or shape
-also remove biennials that bold during their first season
General Production and Processing Techniques
-all seeds should be harvested dry directly off the plants and may need to be protected from birds

-it is possible, and perhaps easier, to cut the entire seed stalk down and thresh in a seed sack, winnowing will likely be necessary

Text Specifics for: endive and escarole; chicory; cardoon; artichoke; sunflower; Jerusalem artichoke (sunroot); black salsify (scorzonera); salsify; Japanese burdock (gobo); shungiku; yacon

Sunflower

The Cucurbitaceae Family

-another family that has been feeding humans for thousands of years and have been found across the planet

-they may be the first plants widely exploited

Family Taxonomy

-these plants are easily identified by their alternating leaves and tendril-bearing vines

Pollination Characteristics and Techniques

-all varieties rely upon insects for pollination

-every plant produces both male and female flowers

-as pollen is accepted from any other variety, plants must be isolated if seeds true-to-type are a goal

-hand pollination may be the safest method to ensure no cross-pollination

-plants may be 'selfed' (male flowers pollinate female ones on the same plant) or 'sibbed' (male flower pollinate female ones on a different plant of the same variety)

-sibbing is better for genetic diversity but selfing is best when specific plant characteristics are being pursued

-the female flowers sit atop an immature fruit (ovary) while the male ones sit atop a straight stem; this is most easily seen in squash and much more difficult in melons and cucumbers

-blossoms should be inspected each morning/evening to see when they are ready to open (mature–begin to show colour along seams and tip may be beginning to open); ones that have opened and wilted are no longer useful for pollinating

-flowers about to open the next morning should be taped shut in the evening and used for pollinating the next morning (hard-shelled gourds are an exception, blooming during the night so taped in the morning and pollinated that evening)

-after the dew has dried in the morning pick a male flower and several inches of its stem; remove the tape and petals, carefully; remove tape from the female flower that should then slowly open; rub pollen from the petal-less onto each section of the female stigma; use several male flowers for each female and then retape female shut; tie a market to the stem of each female pollinated to indicate which fruits were hand-pollinated

-each species require slightly different variations of this approach and is best early in the season during 'crown fruit' formation (first to set) and a few fruits to follow

-plants tend to limit fruits produced but will continue to flower with later fruit only maturing if earlier ones lost (to harvest or damage)

Plant Selection

-growing as many plants as possible help preserve genetic diversity

General Production and Processing Techniques

-fruit must be fully mature before harvest to ensure fertile seeds and the greatest number of such seeds will occur about 3 weeks after the fruit is fully mature and harvested

-most seeds will improve in germination rates if put through a fermentation stage

-seeds should be rinsed and dried on a hard surface, avoiding direct sunlight if temperature may get above 95 degrees fahrenheit

-they are dry enough to store once a seed will break in half as opposed to bending

-store in an airtight container, in a cool, dry, and dark area; or frozen for the longer term

Text Specifics for: watermelon and citron; melons; jelly melon; cucumber; squash, malabar gourd, and calabazilla; hard-shelled gourd; vegetable pear (chayote); winter melon (wax gourd); burr cucumber (west Indian gherkin) caihua (achoecha); angled luffa; smooth luffa; balsam apple; balsam pear (bitter melon); cassabanana; serpent gourd

Cucumber

Squash

The Leguminosae Family
-vegetables in this family have been cultivated for over 6000 years and are second only to grains in importance to humans for food around the world
-when easten with grains, humans gain all the essential amino acids they require
-these plants have also been exploited for uses beyond food (e.g., fiber, timber, dyes, resin, tannins)
Family Taxonomy
-there exist 600+ genera and 12,000+ species; about 25 species are used for food
-Pisum (peas) and Phaseolus (beans) are used both as dry food crops and green vegetables; most others are primarily for dry seeds; leaves, roots, and shoots of a few are considered minor vegetables
-their taxonomic classifications are regularly modified
Pollination Characteristics and Techniques
-flowers are perfect and butterfly-shaped; they are self-pollinating but may be crossed via insects
-pollination requires some form of flower agitation such as wind
-the amount of crossing that occurs is debated and seemingly dependent upon the number/density of pollinators and if other pollen/nectar sources are available
-seed coat colour change usually indicates cross-pollination but won't appear until the following season (thus save seeds in separate labeled containers so crossed ones are more easily identified and removed)
-saving seeds may require isolation depending on presence of other sources of pollen/nectar–if there are numerous larger flowers about the chances of cross-pollination are reduced
-caging should be considered for bush varieties and blossom bags for taller varieties
-cages need to be in place from first blossom to last
-blossom bags may be used but are far more time-consuming; bags can be removed once pods begin to form
Plant Selection
-save seeds from healthy plants that appear true-to-type
-plants should be rogued throughout the season, removing any that are of unusual height or show off-foilage, whose flowers are not true-to-type for shape, colour, or flowers per node
-never save seeds from plants that do not exhibit true-to-type characteristics
General Production and Processing Techniques
-ideally seeds are left to dry on the plant but may, as a last resort, be picked prior if mature and then left to dry
-if frost is imminent, removing the entire plant and hanging it upside down in a warm area to dry pods can be done
-pods tend to spoilt along both sides and seeds should readily fall out
-alternatively, pods may be place in a sack and then jogged upon, hit with a stick, rolled with a rolling oin; or they can be obtained by hand
-winnowing might be necessary

-seeds are susceptible to bean weevils, whose eggs can be laid in flowers and young pods; larvae hatch in seeds and eat their way out; weevil damage can be avoided by freezing pods prior to or after seed harvesting as 3 days at zero degrees will destroy eggs (but best to leave for 5 days)
-ensure seeds are totally dry before freezing or they may be ruined; they should shatter with a hammer strike when appropriately dry
Text Specifics for: peanut; pigeon peas; chick pea (garbanzo); hyacinth bean; runner bean; lima bean (butter bean); common bean; garden pea, edible podded peas; fava bean (broad bean); cow pea; jack bean; sword bean; cluster bean; soybean; lentil; taruvi; ahipa; yam bean (jicama); potato bean; tepary bean; popping bean (nunas); winged bean; asparagus pea; moth bean; adzuki bean; balck gram; mung bean (green gram); rice bean; asparagus bean (yard long bean)

Common Bean
-there exist a huge assortment of this species
-immature pods of green and snap beans and fully mature ones shelled out (shelly beans) are eaten; ones dried on the vine are used as dry or soup beans
Botanical Classification
-genus Phaseolus, species vulgaris
-2200+ varieties of snap and dry beans
Pollination, Crossing and Isolation
-these plants are inbreeding with perfect flowers that are self-pollinating
-if saving seed, do not grow different varieties side-by-side or different varieties with similar coloured seeds
Seed Production, Harvest and Processing
-seeds are easily harvested from dry vines and pods easy to clean
Seed Statistics
-when stored in a cool, dry, dark location, seeds will retain 50% germination for four years
Growing Common Beans From Seed
-all varieties are annuals and have adapted to virtually all climates
-they can be direct-seeded in an inch of soil once the risk of frost has passed although germination is best between 60-85 degrees fahrenheit (taking 3-7 days)
-they like full sun or part shade in hot, dry climates
-trellis support is required for pole varieties and should be thinned to about 3 inches

Garden Pea and Edible Podded Pea
-carbonised seeds have been found dating back to 7000 BC (Switzerland)
-two basic varieties have been domesticated: sweeter ones as a vegetable food; starcher one as a dry good or fodder
-in Asia, further change came with edible pod varieties being domesticated
Botanical Classification
-genus Pisum, species sativum
-they do not cross with any other species of peas or beans
-most vegetable seeds are white or green
-smooth-sided types are more starchy and better for cool climates
Pollination, Crossing and Isolation
-peas are inbreeding with perfect, self-pollinating flowers
-crossing tends to be quite minimal since they tend to self-pollinate prior to the flowers opening
-bees will visit the flowers if there are no other flowers that may cause some cross-pollination
-to be safe, separate varieties by at least 50 feet
-if they must be closer, blossom bagging or caging is needed if seed purity is a concern
Seed Production, Harvest and Processing

-peas mature early and can be left on the vine to dry
-shelling and harvest are easy

Seed Statistics

-when stored in a cool, dark, dry location, seeds will retain 50% germination rate for 3 years

Growing Peas From Seed

-peas are annual, twining vines that tolerate a range of climates but prefer cool weather
-directly seed ½ to 1 inch and will germinate from 45-75 degrees fahrenheit
-plant in full sun or partial shade; thin to 1-2 inches

The Solanaceae Family

-for quite some time Europeans distanced themselves from this family of food, perhaps because of its association of nightshade with poison
-in much of the rest of the world, its fruits and plants provided food

Family Taxonomy`

-there are about 90 genera and 2000 species, most native to Central and South America
-the most widely-used members include: potato, tomato, peppers, and eggplants
-tobacco is the most important non-edible member
-many species produce alkaloids that in small amounts can have a sedative property but can cause death in large quantities
-all members display a characteristic flower: 5 united or partially-united petals that form a symmetrical, wheel-shaped corolla to which 5 stamen are attached near the base

Pollination Characteristics and Techniques

-the species that are cultivated are self-pollinating
-honeybees are not that attracted to the but many other insects are so cross-pollination can occur
-isolation or caging can help prevent cross-pollination of varieties and seeds should be saved from as many plants as possible to maintain genetic diversity

General Production and Processing Techniques

-seeds should be harvested from fully-mature fruit that are sliced, chopped, crushed, or squeezed
-place seed mixture in a bowl, add water, and mix vigorously
-good seeds will sink and the debris and immature seeds can be poured off; repeat this until all that remains are good, clean seeds; pour through a strainer, wipe bottom, and dump onto a ceramic dish to dry; stir seeds 2-3 times a day to help dry and prevent bunching; do not place in sun and place i an airtight container; find a cool, dry, dark location to store–or freeze

Text Specifics for: pepper; tomato; ground cherry, hush tomato, tomatillo; chinese lantern; wild tomatillo; tomatillo (Mexican husk tomato); cape gooseberry (poha); downy ground tomato (yellow husk tomato); purple ground cherry; eggplant; sunberry, garden huckleberry, common nightshade; potato; turee tomato (tamarillo); pepino; naranjilla

Pepper

Tomato

The Umbeliferae Family

-these plants have umbrella-shaped flowers as the pedicels (stem of each flower) radiate out from a common point on the stalk
-there are 200+ species with carrots, celery, fennel, and parsnips the most common grown as vegetables

Family Taxonomy

-the flowers are called umbels, with the main seed stalk forming the primary umbels (contains highest quality seeds) and seeds being ready during hottest par of summer (but will be damaged if over 100 degree fahrenheit)
-some members are grown for thei roots and are biennial (e.g., carrots) requiring overwintering prior to seed production

Pollination Characteristics and Techniques

-while the flowers are perfect, they cannot self-pollinate with anthers shedding pollen before stigmas are receptive (for their 5-7 days)
-as flowers blossom over a protracted period, some anthers will be shedding pollen when the stigma of others plants are receptive
-isolation is the easiest way to prevent cross-pollination but requires at least 3 miles and no wild carrots or fennel in the area
-hand pollination can be employed and needs to be done every day for 2-4 weeks; bagging of immature umbels must be done for at least 10 umbels of each variety that seeds are wanted from; between 7-11 am, take bags off (ensuring no insects present) and brush a camel hair brush over open flowers, making sure to do each flower twice in rotation; rebag and then repeat daily for 2-4 weeks and tagging pollinated umbels
-there is also the caging method
-alternate-day caging requires a cage for each variety with one cage being removed each morning and replaced in the evening; the following morning the alternate variety's cage is removed
-this requires isolation from same species plants or wild relatives in the area
-cages are no longer required once the seeds have been set
-caging with introduced pollinators is also possible but more expensive and complicated

General Production and Processing Techniques

-the seed-to-root-to-seed method is most common
-springtime seeds are planted; crops grow to maturity; roots are dug out in the fall and true-to-type ones saved over the winter (or replanted soon after in warm winter regions) to be replanted in spring for seed stalk production in their second season
-in warm winter regions the seed-to-seed method can be used where seeds are planted in the summer/early fall; plants grow during the winter, bolting in the spring
-this method does not allow for true-to-type root examination and selection
-when seeds are fully formed, umbels can be cut from the stalk
-rubbing the umbels over a properly-sized screen is an efficient means of separating seeds some winnowing might be necessary

Text Specifics for: celery and celeriac; carrot; parsley and parsley root; dill; Peruvian carrot; turnip-rooted chervil; coriander; fennel; parsnip; skirret

Celery

Carrot

Section III: Other Families With Vegetable Members

Amaranthaceae; Basellaceae; Convulvalaceae; Graminea; Labiatae; Liliaceae; Malvaceas; Martyniaceae; Polygonaceae; Portulacaceae; Tetragoniaceae; Valerianaceae