Seed Starting

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DANE COUNTY

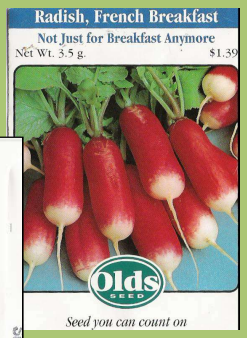
Starting Plants From Seed Overview

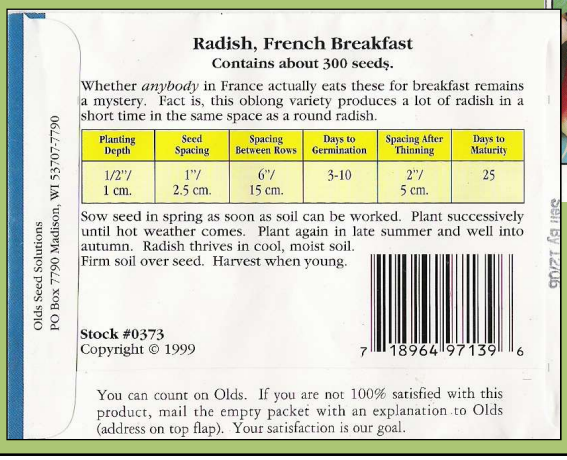
- Purchasing Seeds
- Storing Seeds & Viability
- Timing of Seeding
- Containers
- Media and Sowing
- Germination
- Temperatures
- Lighting
- Watering, Fertilizing
- Thinning
- Transplanting
- Hardening off

Photo credit Sarah Swanson

Starting Plants From Seed

Check the seed packet for information –
Freshness Date
Germination Time
Planting Suggestions





Radish, French Breakfast
Contains about 300 seeds.

Whether *anybody* in France actually eats these for breakfast remains a mystery. Fact is, this oblong variety produces a lot of radish in a short time in the same space as a round radish.

Planting Depth	Seed Spacing	Spacing Between Rows	Days to Germination	Spacing After Thinning	Days to Maturity
1/2"/ 1 cm.	1"/ 2.5 cm.	6"/ 15 cm.	3-10	2"/ 5 cm.	25

Sow seed in spring as soon as soil can be worked. Plant successively until hot weather comes. Plant again in late summer and well into autumn. Radish thrives in cool, moist soil.
Firm soil over seed. Harvest when young.

Olds Seed Solutions
PO Box 7790 Madison, WI 53707-7790

Stock #0373
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You can count on Olds. If you are not 100% satisfied with this product, mail the empty packet with an explanation to Olds (address on top flap). Your satisfaction is our goal.

Seed Packet Info, continued

- Use disease resistant cultivars when available—especially for tomatoes and cucumbers
- Example - Late Blight Resistance: ‘Defiant’, ‘Iron Lady’, ‘Jasper’, ‘JTO-545’, ‘Lemon Drop’, ‘Matt’s Wild Cherry’, ‘Mountain Magic’, ‘Mountain Merit’, ‘Mr. Stripey’, ‘Plum Regal’, ‘Pruden’s Purple’, and ‘Wapsipinicon Peach.’

Disease Resistance Codes

Example: 'Defiant' EB F2 LB V

Code	Disease Resistance or Tolerance
A	Alternaria Stem Canker
BLS	Bacterial Leaf Spot
BMV	Bean Mosaic Virus
CMV	Cucumber Mosaic Virus
DM	Downy Mildew
F	Fusarium Wilt
FF or F2	Fusarium Wilt (Races 1 AND 2)
LB	Late Blight
N	Nematodes
NCLB	Northern Corn Leaf Blight
PM	Powdery Mildew
R	Rust
SCLB	Southern Corn Leaf Blight
St	Stemphylium or Grey Leaf Spot
SW	Stewart's Wilt
T or TMV	Tobacco Mosaic Virus
TSWV	Tomato Spotted Wilt Virus
V	Verticillium Wilt

Source: a-harvest-to-remember-vegetable-gardening.com (defunct)

Seed Starting – Disease Resistance

- Disease resistant seeds can be helpful
  - V= Verticillium wilt,
  - FW or F = Fusarium wilt
  - T = Tobacco Mosaic Virus,
  - BLS = Bacterial Leaf Spot
  - https://www.johnnyseeds.com/growers-library/disease-resistance-codes.html
  - http://vegetablemdonline.ppath.cornell.edu/
    - Lists disease resistant varieties for most vegetable crops

Photo credit: Northcountrypublicradio.org

Seed Starting – Disease Resistance

- Late blight of tomato and potato
- Caused by the fungus-like water mold *Phytophthora infestans*. Some variants/strains cause more severe problems on tomatoes; others more on potatoes.
- Tomato late blight resistant varieties: 'Defiant PHR', 'Iron Lady', 'Jasper', 'JTO-545', 'Lemon Drop', 'Matt's Wild Cherry', 'Mountain Magic', 'Mountain Merit', 'Mr. Stripey', 'Plum Regal', 'Pruden's Purple', and 'Wapsipinicon Peach.' ** Performance may vary depending on late blight variant

Iron Lady Tomato
Photo credit:
Marylandgrows.umd.edu

Seed Starting – Hot Water Seed Treatment if Needed

- Works best for small seed not for old, pelleted, primed, fungicide-treated
- Use a water bath ("water oven") with precise temp/timing control if possible or large pan & precise thermometer
- Wrap seed in cheesecloth & soak (removing any air) to pre-warm in 100°F tap water for 10 minutes
- Submerge pre-warmed seed in water oven for prescribed temp & duration for constant, uniform temp. Too hot injures seeds; too cold won't kill pathogens.
- Place seed in cold tap water for 5 min to quickly end the heat treatment
- Spread seed on a paper towel or screen

Factsheet XHT1261:
https://pddc.wisc.edu/fact-sheet-listing-all

Hot-water treatments can eliminate disease-causing organisms from seed.

Seed Starting

- Fresh seed germinates best
- Store seeds in a cool, dry place. Best kept in tightly closed containers at ± 40° F at low humidity.
- Germination rate decreases with the age of the seed. Some seeds are viable longer than others
- Onions: *1 year*
  Corn and peppers: *2 years*
  Beans, carrots, peas: *3 years*
  Beets, pumpkins, squash, tomatoes, watermelons: *4 years*
  Broccoli, cabbage, cucumbers, lettuce, cantaloupes, radishes, spinach: *5 years*

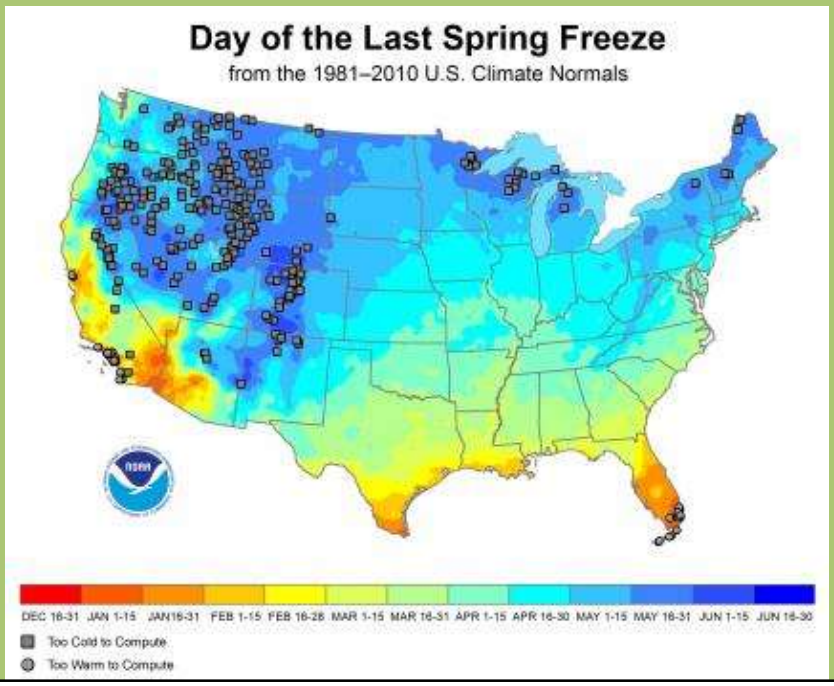
Seed Starting

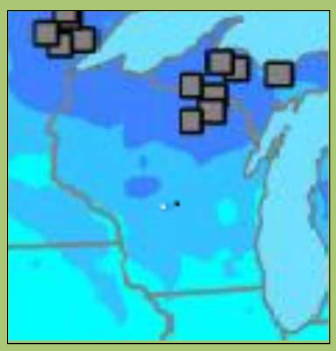
- Germination rates for fresh seed: 80-100% will germinate, 60-75% will grow into useful seedlings
- Seed Roll Test: take 10 seeds, put in a moist paper towel in a plastic bag (not sealed). Keep at 70ºF or so for the amount of time the package says is normal for germination. If rate is 60-90%, plant, but maybe a bit more thickly than usual
- Can also float test peas, beans and corn, if they float, they are likely not viable

Dannylipford.com

https://extension.illinois.edu/news-releases/explore-and-assess-your-seeds-winter

When to start seeds?





https://www.ncdc.noaa.gov/news/when-expect-your-last-spring-freeze

Timing of Seeding in Wisconsin

- Average Frost Free Date to Average First Frost
- This date still has a 50% chance of frost!
- Plant out date should be later to be safe
- Southern Wisconsin
  - Growing season May 15st– Oct. 21st
  - Cole crops out early May, late April
  - Plant out tomatoes/peppers May 15-20
  - Cucurbits out or direct seed 1st week of June
  - If soils and air are still cold, can stunt plants, slowing their growth. Seeds may not germinate if direct seeding into cold soils.

Timing of Seeding in Wisconsin

- West Central Wisconsin
  - Use Memorial Day as a 'plant out' date for warm season plants like tomatoes and peppers, and end of March beginning of April to start those seeds indoors
  - For cool season crops starting inside, like broccoli, cauliflower, cabbage, etc., start about mid-March, as they can go outside earlier, with cooler soil temps and risk of frost.
  - For cucurbits, either seed directly first week in June or start inside end of May and also plant out first week of June

Timing of Seeding in Wisconsin

- Northern and Northeast Wisconsin
- For Superior clay plain soils along the Lake, warm season transplants go out the last week in June. Later in the Northeast.
- Cucurbits are planted indoors and then transplanted out at the end of June.
- The cool season crops, like cole crops, can plant out a few weeks earlier in early June or end of May
- In northern parts of the state, often use raised beds so the soil is warmer.

Timing of Seeding in Wisconsin

- General tips:
  - Refer to the soil temperature handout to gauge when to plant out crops that you are direct seeding outside
  - An inexpensive soil thermometer is helpful
  - Tomatoes and peppers best not planted out till soils are at least 60°F
  - Peas, onion sets and 'seed potatoes' plant directly early (around April 15 in southern WI)
  - Start cucurbits inside if your growing season is short such as the northern or northeastern parts of the state
  - Root crops & beans should be direct seeded

Timing of Seeding

- Squash, cilantro, cucumbers and melons have brittle roots, so if starting indoors, start in peat or paper pots that can be put directly into the ground and will biodegrade
- Still, score the pot with a blade and remove bottom if possible
- Cilantro goes to seed rapidly! Use succession planting, every couple of weeks
- Basil takes a long time to germinate – start early

Why Start Seeds Indoors?

- Why Indoors?
  - Seeds that need warm temperatures to germinate
  - Long season plants
- Supplies needed
  - Clean containers (with drainage)
  - Flats without holes to set containers in
  - Bright natural light or grow-lights (T8 tubes or LEDs)
  - Seed starting medium
  - Location with proper ventilation and temperature (55-65°F cold crops; 65-75°F, warm season crops)

Containers

- Containers
  - Any container with drainage will do (except ones with copper insides or ones that diseased material grew in)
  - Disinfect
    - Clean off any soil with a brush.
    - Soak several minutes in 10:1 bleach solution
  - Good drainage
  - Adequate root space but not excessive
  - Can do tomato seeds in 4 1/2” pots

Containers

- Potential Container types
  - Flats
    - Broadcast or sow rows 2” apart
    - Transplant to packs or pots later
  - Plastic cell packs
  - Peat or coir pots
  - Cardboard egg cartons (these may decay before the seedling can go outside)
  - Deli, yogurt and fast food containers with holes cut into the bottom


Containers
Pots 10
Pots 10
Plastic Cups
UW Extension
DANE COUNTY


Seed Starting Media
Use seed-starting mix to plant seeds indoors as opposed to potting soil
Usually soilless mixes with ground sphagnum, vermiculite. Are porous, fine-textured, hold water, aerated, not high in nutrients, pasteurized, balanced pH
Make sure the medium is moist! Mix in water with clean tools
Use a sprinkling head on the watering can with small holes so seeds aren't washed away
Miracle-Gro
Seed Starting Potting Mix
FAST ROOT DEVELOPMENT
Organic
Seed Starting

Seed Starting

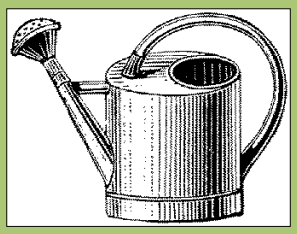
- Moisten media so it almost drips when squeezed
- Fill pot or cell-pack to top with moistened medium
- Gently press down and add more medium if needed, leave a small water reservoir
- Can use fine sand or sugar to help evenly distribute tiny seeds
- Can use Dial-A-Seed planter, or a moistened popsicle stick or pencil eraser to help plant seeds
- After planting, water in gently

Germination

- Factors affecting germination
  - Seed age
  - Moisture
  - Temperature
  - Light (or dark)
  - Oxygen
  - Genetics

Watering Seedlings

- Can water from below in tray before seeds germinate and when seedlings are very small, but don't allow packs or pots to sit in water long
- Allow slight drying between waterings
  - Helps prevent disease
- Don't let seedlings wilt
- Plants shouldn't stay wet, though humidity is important



Soil Temperatures

- SOIL Temperature: Many seeds have minimum, maximum, and optimum soil temperatures at which they germinate.
- Generally, 60° to 75°F works for most plants.
- A heat mat may be helpful and is strongly recommended for peppers. Don't use heating pads meant for people! A single flat mat is about $30-35

https://www.gurneys.com/product/seedling_heat_mat_starter

Soil Temperatures

- Heat mat thermostats can help better regulate temperatures but are expensive (± $50)
- This example monitors media temperature with a water-resistant, stainless steel probe and maintains root temperature at level selected on digital LED controller. Controllable range: 68°-108°F (20°-42°C).

https://www.johnnyseeds.com/tools-supplies/seed-starting-supplies/seedling-heat-mats/

Soil Temperatures

Soil Conditions for Germination

	Minimum	Optimum range	Optimum	Maximum
Beet	40	50-85	85	85
Cabbage	40	45-95	85	100
Cauliflower	40	45-85	80	100
Celery	40	60-70	70	85
Cucumber	60	60-95	95	105
Eggplant	60	75-90	85	95
Lettuce	35	40-80	75	85
Melons	60	75-95	90	100
Onion	35	50-95	75	95
Parsley	40	50-85	75	90
Pepper	60	65-95	85	95
Pumpkin	60	70-90	90	100
Spinach	35	45-75	70	85
Squash	60	70-95	95	100
Swiss chard	40	50-85	85	95
Tomato	50	70-95	85	95

Adapted from Kemble and Musgrove (2006).

https://www.attainable-sustainable.net/planting-seeds/

Air Temperatures

- Day temperatures about 65-75°F
- Night temperatures 60-68 °F (about 10°F lower)
- Cool season crops need cooler day and night temperatures, about 65°F for day and 55°F at night
- May want to use a coldframe for cold crops

Lighting for Seedlings

• Seedlings need bright light. If you use a window for growing, rotate the plants to prevent a phototropic response.

• If using artificial light, grow-lights are preferred. If using traditional fluorescents (not ideal), use a T8 cool-white AND a warm-white tube

• LED's are excellent but can be expensive

• For fluorescents, seedling tops should be 1-2" from the tubes. Keep the lights on about 16 hours each day. Timers are helpful. Spinach and lettuce will bolt with more than 10-12 hrs. Move either lights or flats as the seedlings grow so they don't end up in the lights.

Lighting for Seedlings

Type	Tube Diameter	Light output (initial lumens* per tube)	Tube Life (hrs.)**	Notes
T-12 (40w)	1 1/2 inches	1500 - 3200	10,000 -20,000	Older standard
T-8(32w)	1 inch	2800	30,000 -40,000	20-25% more efficient than T-12
T-5 (54w)	5/8 inch	5000	30,000	9% more effic. than T-8
T-12 (Wide Spectrum)	1 1/2 inches	1700	20,000	Type of "Gro-Light" (adds red and far-red to blue light)

*Lumens measures light intensity over the visual spectrum- the brightness that we see.
** Over time the bulbs begin to lose their intensity. T-8 bulbs have a slower period of decrease, losing about 10% of initial brightness after 7,000 hours. T-12 bulbs can lose 20% after the same number of hours.

Source: https://extension.umd.edu/hgic/topics/grow-lights#

Fluorescent Lighting for Seedlings

LED Lighting for Seedlings

- LEDs (light-emitting diodes) produce a high amount of light with lower energy needs. Some LEDs produce more than twice the amount of light per watt compared to fluorescents
- Some LEDs are designed to produce red and blue light wavelengths only and give off a purple glow, unlike full spectrum lights simulating daylight. LEDs in white colors also work for seeds; some LED tube lights will fit in shop light ballasts

More info at https://www.johnson.k-state.edu/lawn-garden/agent-articles/vegetables/lighting_options_for_Seeds.html

LED Lighting for Seedlings

- For red/blue LED grow lights, because of higher photosynthetic active radiation (PAR) some LEDs should be positioned farther from plant tops.
- With both LEDs and fluorescent look for lights that include the cooler blue spectrum, these will often be marked as 5000-6500K (Kelvin).
- Highly expensive LEDs with hundreds of watts, UV and infrared spectrums are not needed for seeds

https://www.johnson.k-state.edu/lawn-garden/agent-articles/vegetables/lighting_options_for_Seeds.html

Germination

- Barriers to Germination
- Dormancy—may need a cold period (vernalization) to break dormancy
- Scarification
  - Seed may have evolved to pass through an animal or fire (like pine cones' seeds) before they will germinate
  - Soaking or scratching the seed https://morningchores.com/soaking-seeds/
- Stratification
  - Exposing seed to freeze/thaw cycles degrades chemical inhibitors causing dormancy

Soaking seeds

- Not all seeds should be soaked but large ones with thick seed coats can benefit
- In general, small seeds like carrots should not be soaked
- It is recommended that you only soak most seeds for 12 to 24 hours
- Veg seeds recommended for soaking include: beets, Swiss chard, peas, beans, okra, cucurbits like cucumbers, pumpkins, melons, summer and winter squash, corn, dill, cilantro, and other large-seeded herbs

https://www.attainable-sustainable.net/soaking-seeds/

Soaking seeds

- For more information:
- https://morningchores.com/soaking-seeds/
- https://www.gardeningknowhow.com/garden-how-to/propagation/seeds/soaking-seeds.htm

https://greenbeanconnection.wordpress.com/2011/02/25/seed-soaking-presprouting-tips-part-2/

Winter Sown for Germination

- In Jan-Feb, for natives, annuals and perennials that need/prefer cold stratification or cooler temps for germination
- Some species: natives, violas, bachelor buttons, delphinium, poppies, nicotiana, calendula
- Vegetables include: spinach, Brussells sprouts, and kale
- https://extension.psu.edu/successful-winter-seed-sowing.
- https://northerngardener.org/winter-sowing-perennials-works/
- http://wintersown.org/index.html

Photo Credit: Jen Walkington

Winter Sown for Germination

- Milk or water jugs; can also use liter soda bottles, cut just below handle, leave 'hinge' on non-handle side
- Punch drainage holes in bottom
- Fill with 3" of lightly packed potting mix, water well and drain till evenly moist but not wet
- Sow seeds; cover to planting depth on seed packet
- Close jug, secure with duct tape, & label with permanent marker. No caps on so water can get in
- Set jugs outside in sun but out of wind, not under eaves or next to house.

https://monarchbutterflygarden.net/winter-sowing-milkweed-seeds-prepare-containers/

Winter Sown for Germination

- When you see seeds germinating in early spring, open jugs, check if light watering is needed
- Leave tops open on warm days, but re-close before night.
- Seedlings may need to be transplanted into larger containers before putting in ground if weather stays cold well into spring.

https://thereidhomestead.com/my-2018-winter-sowing-results-are-in/

Hydroponics for Germination Example

- Supplies for a simple system
  - Water and growing solution
  - Tub
  - Rock wool
  - Clay pellets
  - Aerator
  - Grow light

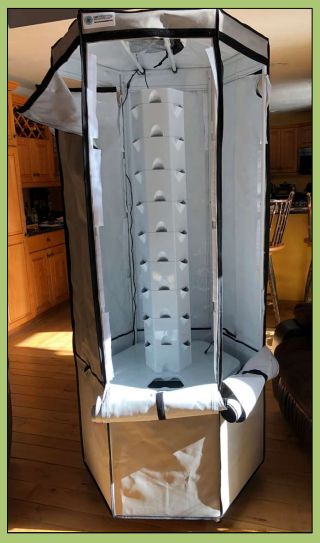
Hydroponics for Germination

Photo courtesy of Kent Wright

Hydroponics for Germination Example

Photo credit: http://lisalehmann.com/garden.html

Hydroponics for Germination Example



http://lisalehmann.com/garden.html

Aerospring™ garden. Stands about 6’ high and holds 27 plants in a center tower

Tips for Growing Certain Seeds

- Beets
- Eggplants
- Onions
- Peppers

Germination of Beets Tips

- Soaking prior to planting may help; seeds are inside papery capsules
- Good seed to soil contact
- Seeds may not germinate in hot weather or cold soil.
- Monogerm varieties have just one seed in the capsule and need no thinning
- May get sweeter beets with late summer/early fall sowing

https://www.growveg.com/guides/beets-for-beginners/

Germination of Eggplants

- Start eggplant seeds inside about eight weeks before planting outside, or outside the first week of June.
- May want to soak briefly
- Germination can be 14 days (but might be only 5)
- If starting inside, a soil temperature of 80°F is best.
- Start in peat pots to minimize transplant shock
- Transplant outdoors after nighttime low temperatures have risen above 60°F.

https://garden.org/thread/view/25181/

Germination of Onions

- If start inside 8-10 weeks before May 15, outside 4-6 weeks before, temps should be 50°F outside as they may bolt if below that for too long
- Fresh seed works best, in 4-8 days with bottom heat 65-75°F, may snip 'loop' after germination
- Shallow rooted, water important but don't overwater
- When 3" tall, can snip back to 1-1½" so they don't fall over
- https://planttalk.colostate.edu/topics/vegetables/1808-growing-onions-seed/
- https://www.growveg.com/guides/ten-top-tips-for-growing-onions-from-seed/

https://www.growveg.com/guides/ten-top-tips-for-growing-onions-from-seed/

https://www.myrollinghillsfarm.com/blog/trimming-onion-starts-for-stronger-plants

Germination of Peppers

- Plant seeds one-fourth inch deep in soilless seed mix.
- Use a heating mat to keep the flat at 80°F to 90°F until seedlings
- Especially hot pepper seeds, germinate much better when consistently moist at 85˚-90˚ F during the germination
- Watch moisture, as heating mats will dry the mix out faster. A soil temperature of 70°F is ideal. Warm soil is better tha

https://extension.umn.edu/vegetables/growing-peppers-home-gardens

Thinning

- Thinning out of seedlings can be done as soon as the first set of leaves comes out; is done to prevent physical and disease problems.
- Root crops like carrots, onions, radishes, beets must be thinned so they have room to develop
- Snip off weaker plants at soil level with a small scissors so roots of the “keepers” are not damaged or disturbed.
- Not everything needs thinning – leaf lettuce can be closer

This will be really hard to thin by scissors at this point, but could uproot and gently separate seedlings

Fertilizer

- Apply after seeds germinate and reach about ½-1 inch in height.
- A half-strength dose of a water-soluble synthetic fertilizer such as 10-10-10 fertilizer OR a liquid organic product like fish emulsion or pasteurized compost tea can be used.
- Use the synthetic fertilizer every two weeks; may need to apply the organic product more often depending on its analysis.

Transplanting

- Move to larger container after thinning <u>if needed</u>
- Handle seedling gently by cotyledons or leaves & support from below when transplanting, don't pull the stem
- Lift seedlings using a small flat tool (ex. plastic knife or popsicle stick)
- Gently tease apart tangled plants/roots
- Use a "dibble" (pencil or spoon) to make hole in the new media and press in gently, then water

crystalgh.hubpages.com

Hardening Off

- After seedlings establish, move them to an airy, cooler location, with air temperatures of 55°F to 60°F night and 65°F to 70° F day (in general).
- Cold frames work well https://extension2.missouri.edu/g6965
- Hardening off alters the quality of plant growth through cuticle development so plants can handle rapid environmental changes.

Hardening Off

- Move seedlings to a sheltered location outdoors for a couple hours
- Best in the early morning or early evening.
- Start a couple of weeks before planting the seedlings in the garden.
- Each day the plants stay outside longer and in sunnier, more exposed locations.

Direct Seeding Outdoors

- Direct seeding outside avoids transplant shock
- Shorter season available than for seedlings started indoors, which means a later harvest
- Less work but more risk with weather, insects, disease, erosion, squirrels and rabbits
- Radish, leeks, carrots are best direct-seeded outside. Lettuce and spinach can be started inside or out. Tomatoes and peppers best started indoors
- Peas, onion sets & potato 'starts' can go out on April 15, depending on weather in Madison
- Beans go out late May to early June depending on weather in Madison

Seed Starting Resources

- "The Seed-Starter's Handbook", Nancy Bubel
- https://learningstore.extension.wisc.edu/
  - The Vegetable Garden A1989
- "Ball Culture Guide: Encyclopedia of Seed Germination", Jim Nau
- "The Plant Propagator's Bible", Miranda Smith
- Virginia Extension:
  - http://pubs.ext.vt.edu/426/426-316/426-316.html
- "Vegetable Gardening in the Midwest" C.E Voigt and J.S. Vandemark

Thank You!

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Extension
UNIVERSITY OF WISCONSIN–MADISON
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