

Cold-Hardy Winter Vegetables

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Winter Kill Temperatures of Winter-Hardy Vegetables 2021 revision

Unless otherwise stated, these are killing temperatures of crops *outdoors without any rowcover*. All greens do a lot better with protection against cold drying winds. Note that repeated cold temperatures can kill crops that can survive a single dip to a low temperature, and that cold winds, or cold wet weather can destroy plants quicker than simple cold. Crops get more damage when the weather switches suddenly from warm to cold. If the temperature drops 5 or more Fahrenheit degrees (about 3 C degrees) from recent temperatures, there can be cold damage. The forecaster in Raleigh, NC says it needs 3 hours at the critical temperature to do damage. Your experience with your soils, microclimates, and rain levels may lead you to use different temperatures in your planning.

35°F (2°C): Basil.

32°F (0°C): Bush beans, cauliflower curds, corn, cowpeas, cucumbers, eggplant, limas, melons, okra, some pak choy, peanuts, peppers, vines of potatoes, squash and sweet potato, tomatoes.

27°F (-3°C): Many cabbage varieties, *Sugarloaf* chicory (takes only light frosts).

25°F (-4°C): Some cabbage, chervil, Belgian Witloof chicory roots for chicons, and hearts, Chinese Napa cabbage (*Blues*), dill (*Fernleaf*), some fava beans (*Windsor*), annual fennel, some mustards (*Red Giant*, *Southern Curled*) and Asian greens (*Maruba Santoh*, *mizuna*, most *pak choy*, *Tokyo Bekana*), onion scallions (some are much more hardy), radicchio, rhubarb stems and leaves.

22°F (-6°C): Some arugula (some varieties are hardier), *Bright Lights* chard, endive (Escarole may be a little more frost-hardy than Frisée), large leaves of lettuce (protected hearts and small plants will survive colder temperatures).

20°F (-7°C): Some beets (*Bulls Blood*, *Chioggia*), broccoli heads (maybe OK to 15°F (-9.5°C)), some Brussels sprouts, some cabbages (the insides may still be good even if the outer leaves are damaged), some cauliflower varieties, celeriac, celtuce (stem lettuce), some collards (*Georgia Cabbage Collards*, variegated collards), some head lettuce, some mustards/Asian greens (*Tendergreen*, *Tyfon* *Holland* greens), flat leaf parsley, radicchio (both *Treviso* and *Chioggia*), radishes (*Cherry Belle*), most turnips (*Noir d'Hiver* is the most cold-tolerant variety).

Large oat plants will get serious cold damage. Oats seedlings die at 17°F (-8°C)

Canadian (spring) field peas are hardy to 10-20°F (-12 to -7°C).

15°F (-9.5°C): Some beets (*Albina Verduna*, *Lutz Winterkeeper*), beet leaves, some broccoli and cauliflower leaves, some cabbage (*Kaitlin*, *Tribute*), covered celery (*Ventura*), red chard, cilantro, fava beans (*Aquadulce Claudia*), *Red Russian* and *White Russian* kales, kohlrabi, some lettuce, especially medium-sized plants with 4-10 leaves (*Marvel of Four Seasons*, *Olga*, *Rouge d'hiver*, *Tango*, *Winter Density*), curly leaf parsley, rutabagas (*American Purple Top Yellow*, *Laurentian*), broad leaf sorrel, most covered turnips, winter cress.

12°F (-11°C): Some beets (*Cylindra*), some broccoli perhaps, some Brussels sprouts, some cabbage (*January King*, *Savoy* types), carrots (*Danvers*, *Oxheart*), most collards, some fava beans (mostly cover crop varieties), garlic tops if fairly large, *Koji* greens, most fall or summer varieties of leeks (*Lincoln*, *King Richard*), large tops of potato onions, covered rutabagas, some turnips (*Purple Top*).

10°F (-12°C): Covered beets, *Purple Sprouting* broccoli for spring harvest, a few cabbages (*Deadon*), chard (green chard is hardier than multi-colored types), some collards (*Morris Heading* can survive at least one night at 10°F), *Belle Isle* upland cress, some endive (*Perfect*, *President*), young *Bronze fennel*, *Blue Ridge* kale, probably *Komatsuna*, some leeks (*American Flag* (*Broad London*), *Jaune du Poiteau*), some covered lettuce (*Pirat*, *Red Salad Bowl*, *Salad Bowl*, *Sylvesta*, *Winter Marvel*), *Chinese Thick-Stem Mustard* may survive down to 6°F (-14°C), covered winter radish (*Daikon*, *China Rose*, *Shunkyo Semi-Long* survive 10°F/-12°C), *Senposai* leaves (the core of the plant may survive 8°F/-13°C), large leaves of savoyed spinach (more hardy than smooth-leaved varieties), *Tatsoi*, *Yukina Savoy*. Oats cover crop of a medium size die around 10°F (-12°C). Large oat plants will die completely at 6°F (-17°C) or even milder.

5°F (-15°C): Garlic tops even if small, some kale (*Winterbor*, *Westland Winter*), some leeks (*Bulgarian Giant*, *Laura*), some bulb onions, potato onions and other multiplier onions, smaller leaves of savoy spinach and broad leaf sorrel. Many of the Even' Star Ice Bred greens varieties and the *Ice-Bred White Egg turnip* are hardy down to 6°F (-14°C), a few unprotected lettuces if small (*Winter Marvel*, *Tango*, *North Pole*, *Green Forest*).

0°F (-18°C): Chives, some collards (*Blue Max*, *Winner*, *McCormack's Green Glaze*), corn salad (mâche), garlic, horseradish, Jerusalem artichokes, Even' Star *Ice-Bred Smooth Leaf* kale, a few leeks (*Alaska*, *Durabel*, *Tadorna*); some bulb onions, yellow potato onions, some onion scallions, (*Evergreen Winter Hardy White*, *White Lisbon*), parsnips (probably even colder), salad burnet, salsify (?), some spinach (*Bloomsdale Savoy*, *Long Standing Bloomsdale*, *Olympia*). *Walla Walla* onions sown in late summer are said to be hardy down to -10°F (-23°C), but I don't trust below 0°F (-18°C)

Crimson clover is hardy down to 0°F (-18°C) or perhaps as cold as **-10°F (-23°C)**

-5°F (-19°C): Leaves of overwintering varieties of cauliflower, *Vates* kale survives although some leaves may be too damaged to use. *Lacinato Rainbow Mix* kale may survive this temperature.

-10°F (-23°C) Austrian Winter Field Peas and Crimson clover (used as cover crops).

-15°F (-26°C) Hairy vetch cover crop – some say down to -30°F (-34°C)

-20°F (-29°C) Dutch White clover cover crops – or even -30°F (-34°C)

-30°F to -40°F (-34°C to -40°C): Narrow leaf sorrel, Claytonia and some cabbage are said to be hardy in zone 3. I have no personal experience of this.

-40°F (-40°C) Winter wheat and winter rye (cover crops).

Hoophouse Notes

In a double-layer hoophouse (8F/5C warmer than outside on winter nights) **plants can survive 14F/8C colder** than they can outside, without extra rowcover; **with thick rowcover** (1.25oz Typar/Xavan) at least **21F/12C colder** than outside without. For example, salad greens in our hoophouse in zone 7a survive nights with outdoor lows of 14°F (-10°C). Russian kales, lettuce, mizuna, senposai, spinach, tatsoi, turnips, Yukina Savoy survived a *hoophouse* temperature of 10.4°F (-12°C) without rowcover, -2.2°F (-19°C) with *Bright Lights* chard got frozen leaf stems. Outdoor temperatures fell to -12°F (-24°C)!

Lettuce varieties for a solar-heated winter greenhouse or hoophouse in zone 7a: (hardest are in bold) **Buckley, Ezrilla, Green Forest, Green Star, Hampton, Hyper Red Ruffled Wave, Lollo Rossa, Marvel of Four Seasons, Merlot, New Red Fire, North Pole, Oscarde, Outredgeous, Pirat, Red Cross, Red Sails, Red Salad Bowl, Red Tinged Winter, Revolution, Rouge d'Hiver, Salad Bowl, Sylvesta, Tango, Winter Marvel, Winter Wonderland.**

Cold-tolerant early spring lettuces include *Buckley, Crawford, Green Forest, Hampton, Merlot, New Red Fire, Revolution, Simpson Elite, Susan's Red Bibb* and *Swordleaf*.

Three Ranges of Hardiness

Crops to keep alive in the ground into winter to 22°-15°F (-6°C to -9°C), then harvest.

Store: Beets, cabbage, carrots, celeriac, kohlrabi, winter radish (including daikon), rutabagas, turnips,

Use: Asian greens, broccoli, cabbage, chard, lettuce, radishes

Hardy crops to store in the ground and harvest during the winter. In zone 7, they need to be hardy to 0°-10°F (-17.8°C to -12.3°C): Collards, horseradish, Jerusalem artichokes, kale, leeks, parsnips, scallions, spinach

Overwinter crops for spring harvests before the main season: Cabbage, carrots, chard, collards, garlic and garlic scallions, kale, multiplier onions (potato onions), scallions, spinach

Cold-hardy Lettuce

Particularly cold-hardy for outdoors: Brune d'Hiver, **Buckley, Ezrilla, Green Forest, Hampton, Lollo Rossa, Merlot, North Pole, Red Tinged Winter, Revolution, Rouge d'Hiver, Tango, Winter Marvel**

For a frost-free unheated winter greenhouse in zone 7a: Buckley, Ezrilla, Green Forest, Green Star, Hampton, Hyper Red Ruffle Waved, Marvel of Four Seasons, Merlot, New Red Fire, North Pole, Pirat, Red Cross, Red Sails, Red Salad Bowl, Red Tinged Winter, Revolution, Rouge d'Hiver, Salad Bowl, Sylvesta, Tango, Winter Marvel, Winter Wonderland.

Resources (May 2021)

- ATTRA [attra.ncat.org/Season Extension Techniques for Market Farmers](http://attra.ncat.org/Season_Extension_Techniques_for_Market_Farmers), etc.
- SARE www.sare.org/ A searchable database of research findings. See *Season Extension Topic Room*
- articles.extension.org/organic_production and eorganic.info Reliable publications, webinars, videos, trainings and support.
- Growing Small Farms: growingsmallfarms.ces.ncsu.edu/* Farmer Resources.
- Jean-Paul Courtens, Roxbury Farm <https://www.roxburyfarm.com/roxbury-agriculture-institute-at-phia-farm> *Whole farm Approach; Biodynamic Practices; Harvest Manual; Crop Manual; More Info for Farmers: Soil Fertility Practices; 100 Member CSA plans: CSA Share List, Greenhouse Plan, Field Plan.*
- Johnnyseeds.com. Growers' Library, Winter Growing Guide <https://www.johnnyseeds.com/growers-library/vegetables/winter-growing-guide-high-tunnel-scheduling.html>. The first two of 9 sections in the guide.
- <https://weatherspark.com/> Weather records for your area. Fun!
- Soil temperatures www.greencastonline.com/tools/soil-temperature

Resources – Asian Greens

- Grow Your Own Chinese Vegetables*, Geri Harrington, 1984, Garden Way Publishing. Includes the names for these crops in different cultures.
- Growing Unusual Vegetables*, Simon Hickmott, 2006, Eco-Logic books, UK.
- Oriental Vegetables: The Complete Guide for the Garden and Kitchen*, Joy Larkham, revised edition 2008, Kodansha, USA
- Asian Vegetables*, Sally Cunningham, Chelsea Green
- The Chinese Kitchen Garden, Wendy Kiang-Spray*, 2017, Workman Publishing
- Kitazawa Seeds kitazawaseed.com/ & Evergreen Seeds have the most choices.
- Evergreen's helpful clickable list. evergreenseeds.com/asveglis.html
- Fedco Seeds fedcoseeds.com/ and Johnny's johnnyseeds.com/ have a good range.
- Wild Garden Seed has many interesting home-bred varieties. Search under Mustard. wildgardenseed.com
- ATTRA *Cole Crops and Other Brassicas: Organic Production* attra.ncat.org/attra-pub/summaries/summary.php?pub=27

Four Sets of Storage Conditions for 25 Crops

A= **Cold and Moist:** 32°F–40°F (0°C–5°C), 80%–95% humidity—refrigerator or winter root cellar conditions. Most roots, greens, leeks
B= **Cool and Fairly Moist:** 40°F–50°F (5°C–10°C), 85%–90% humidity—root cellar. Potatoes
C= **Cool and Dry:** 32°F–50°F (0°C–10°C), 60%–70% humidity—cooler basements and barns. Garlic and onions
D= **Warm and Dry to Fairly Moist:** 50°F–60°F (10°C–15°C), 60%–70% humidity—basements. Sweet potatoes, winter squash.

Table of Storage Conditions. The Summary column indicates the general conditions needed for each crop, and allocates each crop to one of four groups: A=Cold and Moist; B=Cool and Fairly Moist; C= Cool and Dry; D=Warm, Dry to Fairly Moist. (Compared to the Bubels' five groups, I don't distinguish between Very Moist and Moist in Cold storage conditions.) By providing storage spaces with these four types of conditions, these twenty-five crops can be stored.

Crop	°F	°C	% Humidity	Need for Ventilation	Summary	Storage Life in months	Notes
Apples	30–40	–1–4	90–95	Low	B: Cool and Fairly Moist	2–7	
Beets	33–40	1–4	95–100	Low	A: Cold and Moist	4–6	Perforated plastic bag in cellar. Short-term inground. Clamp. Temperatures above 45°F (7°C) cause sprouting.
Cabbage	32–34	0–1	90–95	Low	B: Cool and Fairly Moist	5–6	Net bag in cellar. Or dig up and hang upside down. Short-term inground. Clamp. Light reduces yellowing and weight loss.
Carrots	32–41	0–5	90–95	Medium	A: Cold and Moist	7–9	Perforated plastic bag in cellar. Inground. Clamp. Temperatures above 45°F (7°C) cause sprouting.
Celeriac	32–40	0–4	97–98	Medium	A: Cold and Moist	4–8	Well-perforated plastic bag in cellar. Short-term inground. Temperatures above 45°F (7°C) cause sprouting.
Celery	32	0	95–100	Medium	A: Cold and Moist	1–3	Can dig up and replant in buckets in cellar.
Chinese cabbage	32–41	0–5	99–100	Medium	A: Cold and Moist	1–3	Perforated plastic bag, or dig up and replant in buckets in cellar
Daiikon radish	32–34	0–1	95–100	Low	A: Cold and Moist	4	Perforated plastic bag in cellar. Clamp. Temperatures above 45°F (7°C) cause sprouting.
Garlic	32–38 or 65–86	0–3 or 18–30	60–70	Low above 50°F (10°C)	C: Cool and Dry. Or D: Warm and Dry	6–7 (1–3 months at warm temps)	Net bag. Keep warm or keep cold. Never 40°F–56°F (4°C–13°C), or they will sprout. Never warm after cold either.
Ginger root	54–57	12–14	85–90	Low	D: Warm and Fairly Moist	4–6	If stored with other warm-storage crops, will need extra humidifying.
Horseradish	30–32	–1–0	90–100	Low	A: Cold and Moist	10–12	Perforated plastic bag or plastic bucket, no lid, in cellar. Inground. Clamp. Temperatures above 45°F (7°C) cause sprouting.
Jerusalem artichoke	32–34	0–2	90–95	Low	A: Cold and (Fairly) Moist	4–10	Paper or plastic bag in cellar. Inground. Clamp.
Kohlrabi	32	0	95–100	Medium	A: Cold and Moist	2–3	Perforated plastic bag in cellar. Clamp.
Leeks	32	0	95–100	Medium	A: Cold and Moist	3	Perforated plastic bag, or plastic bucket with small amount of water, or dig up and replant in buckets in cellar. Inground.
Onions (bulbs)	32–40 or 60–90	0–4 or 16–32	60–70	Low	C: Cool and Dry. Or D: Warm and Dry	1–8	Net bag. Keep warm or keep cold. Never 45°F–55°F (7°C–13°C), or they will sprout. Never warm after cold either.
Parsnips	32–34	0–1	95–100	Medium	A: Cold and Moist	6	Perforated plastic bag in cellar. Inground. Clamp. Temperatures above 45°F (7°C) cause sprouting.
Pears	29–31	–1.5 to –0.5	90–95	Low	B: Cool and Fairly Moist	2–8	Open trays. Temperature requirements vary with variety, and are critical.
Potatoes	40–45	4–7	90–95	Low	B: Cool and Fairly Moist	5–10	Plastic or wood crates, paper bags in cellar. Protect from light. Below 40°F (4°C) the flavor deteriorates.
Radish, winter	32	0	95–100	Low	A: Cold and Moist	4	Perforated plastic bag in cellar. Clamp. Temperatures above 45°F (7°C) cause sprouting.
Rutabagas	32	0	95–100	Low	A: Cold and Moist	4–6	Perforated plastic bag in cellar. Inground. Clamp. Wax unnecessary. Temperatures above 45°F (7°C) cause sprouting.
Salsify	32	0	95–98	Low	A: Cold and Moist	2–4	Can dig up and replant in buckets in cellar. Clamp. Temperatures above 45°F (7°C) cause sprouting.
Squash, winter	50–60	10–15	50–75	Med	D: Warm and Dry	2–12	Storage life varies widely with variety.
Sweet potatoes	55–65	13–18	70–80	Low after curing	D: Warm but not too Dry	4–10	Never below 50°F (10°C). Ideal temperature 55°F–59°F (13°C–15°C). Temps above 65°F (18°C) hasten sprouting.
Tomatoes, ripening green	55–70	13–21	75–85	Low	D: Warm but not too Dry	1–3	Egg trays, apple trays
Turnips	32	0	90–95	Low	A: Cold and Moist	4–5	Perforated plastic bag in cellar. Inground. Clamp. Temperatures above 45°F (7°C) cause sprouting.

Resources - Season Extension

- Extending the Season: Six Strategies for Improving Cash Flow Year-Round on the Market Farm* a free e-book for online subscribers to Growing for Market magazine
- Janet Bachmann, *Season Extension Techniques for Market Gardeners*, ATTRA, 2005. attra.ncat.org/attra-pub/summaries/summary.php?pub=366
- Fall and Winter Gardening Quick Reference*, Southern Exposure Seed Exchange, www.southernexposure.com/growing-guides/fall-winter-quick-guide.pdf
- www.motherofahubbard.com Winter Vegetable Gardening
- Solar Gardening: Growing Vegetables Year-Round the American Intensive Way*, Leandre Poisson, Gretchen Poisson and Robin Wimbiscus, 1994, Chelsea Green – good book on making small structures.
- Greenhouse and Hoophouse Grower's Handbook – Organic Vegetable Production Using Protected Culture*, Andrew Mefferd,
- Washington State University Extension, *Storing Vegetables and Fruits at Home* pubs.extension.wsu.edu/storing-vegetables-and-fruits-at-home
- USDA *Agriculture Handbook 66 (1986)* hard to find old version.

Resources – Hoophouses

- University of Minnesota *Deep Winter Greenhouse* extension.umn.edu/growing-systems/deep-winter-greenhouses
- U of MN *High Tunnel Production Manual* www.extension.umn.edu/garden/fruit-vegetable/#high-tunnel
- U of MN *Cold-Climate Greenhouse Resource* cura.umn.edu/publications/catalog/cap-186
- The Northlands Winter Greenhouse Manual*, Carol Ford & Chuck Waibe mosesorganic.net/product/northlands-winter-greenhouse-manual-the/
- HighTunnels.org: hightunnels.org/category/for-growers/growing-in-high-tunnels/ or hightunnels.org/for-growers/
- Penn State *High Tunnel Production Manual*, William Lamont, \$25 extension.psu.edu/high-tunnel-manual
- High Tunnels: Using Low Cost Technology to Increase Yields, Improve Quality, and Extend the Growing Season* by Ted Blomgren, Tracy Frisch and Steve Moore. University of Vermont Center for Sustainable Agriculture. <https://www.sare.org/resources/high-tunnels/>
- High Tunnel Winter Cropping Systems*, Lewis Jett, SARE. Slideshow and audio. <https://northeast.sare.org/resources/high-tunnel-winter-cropping-systems/>

Resources – Books

- The Market Gardener*, Jean-Martin Fortier, New Society Publishers
- The Complete Know and Grow Vegetables*, J K A Bleasdale, P J Salter et al.
- Knott's Handbook for Vegetable Growers*, Maynard and Hochmuth extension.missouri.edu/sare/documents/KnottsHandbook2012.pdf
- The New Seed Starter's Handbook*, Nancy Bubel, Rodale Books
- The Organic Farmer's Business Handbook*, Richard Wiswall, Chelsea Green
- Sustainable Vegetable Production from Start-up to Market*, Vern Grubinger, host31.spidergraphics.com/nra/doc/fair%20use%20web%20pdfs/nraes-104_web.pdf NRAES
- The New Organic Grower* and *The Winter Harvest Manual*, Eliot Coleman,
- Crop Planning for Organic Vegetable Growers*, Daniel Brisebois and Frédéric Thériault (Canadian Organic Growers www.cog.ca)
- The Chinese Greenhouse: Design and Build a Low-Cost, Passive Solar Greenhouse*, Dan Chiras, New Society Publishers. Solar-heated, earth-sheltered, well-insulated, plastic-glazed structures, making it possible to grow warm weather crops in winter.
- Growing Great Garlic*, Ron Engeland, 1991, Filaree

Resources – My Slideshows www.slideshare.net/ Search for Pam Dawling. You'll find:

- Cold-hardy Winter Vegetables*
- Cover Crops for Vegetable Growers*
- Crop Planning for Sustainable Vegetable Production*
- Crop Rotations for Vegetables and Cover Crops*
- Diversify your Vegetable Crops*
- Fall and Winter Hoophouse*
- Fall Vegetable Production*
- Feeding the Soil*
- Growing Great Garlic*
- Growing Sweet Potatoes from Start to Finish*
- Hoophouse Production of Cool Season Crops*
- Lettuce Year Round*
- Many Crops, Many Plantings, to Maximize High Tunnel Efficiency*
- Producing Asian Greens*
- Production of Late Fall, Winter and Early Spring Vegetable Crops*
- Season Extension*
- Sequential Planting of Cool Season Crops in a High Tunnel*
- Spring and Summer Hoophouses*
- Storage Vegetables*
- Succession Planting for Continuous Vegetable Harvests*
- Sustainable Farming Practices.*
- The Seed Garden*
- Year Round Vegetable Production*
- Year Round Hoophouse Vegetables*