March 16, 2019 Hyattsville Horticultural Society meeting/seed starting workshop

Why start seeds inside?

- earlier or out-of-season flowering and/or harvest
- rare, scarce, or expensive seeds
- slow-growing seedlings need a head start
- more control plant location than direct seeding
- protect seedlings from spring frosts, summer heat, getting eaten by squirrels, etc.
- control over photoperiod or other environmental conditions
- avoid accidentally weeding out your desired seedlings (my most common problem!)
-

What is needed? (in addition to space and time to putter, of course)

1. Growth medium and containers
2. Light
3. Heat (in some cases)
4. Water and nutrients
5. Other germination requirements
6. HARDENING-OFF before placing outside (gradual acclimation)
7. Planning

NOTE/DISCLAIMER: everyone has different experiences. Some of what I think is good/bad/important may not be for you, e.g. some people use yard soil with no problems, some people get peppers to germinate without heat, etc. I'm just sharing my experiences and what is usually reported by others.

1. Growth medium and containers

--can be simple or complex, free or expensive, made, recycled, or purchased.
Creativity is the mother of invention: reused plastic cups, tubs, tofu containers, etc.

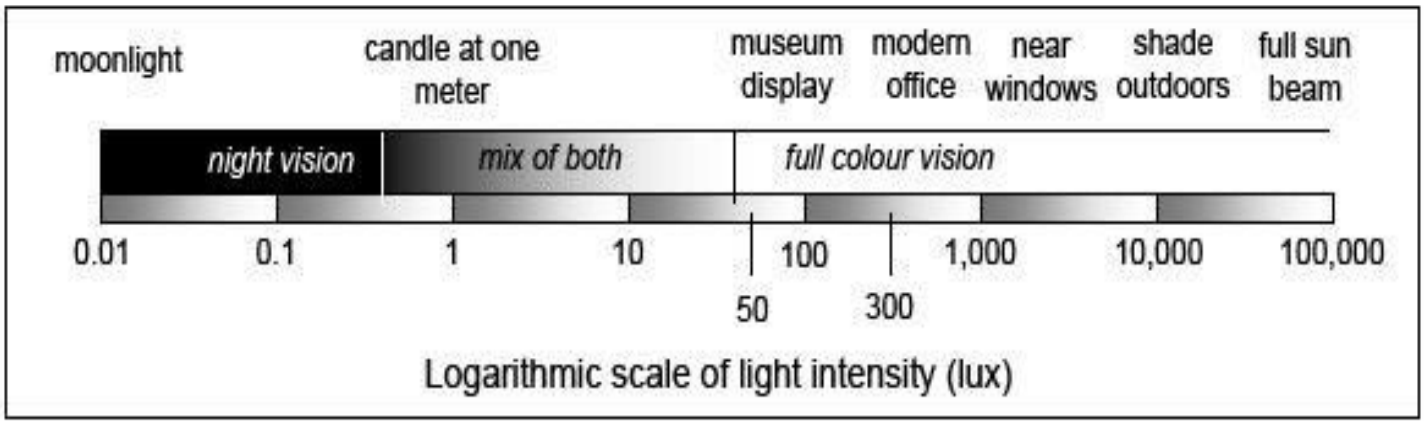
OR try a soil blocker and skip the container—requires a growth medium that has a lot of peat or other fibrous material to hold shape. I'm happy to let you use my soil blockers, just ask.
(DEMO—make small and medium soil blocks to take home, see previously planted ones).

If you are growing seeds inside for more than about a week, you will either need a growth medium that contains nutrients already, or will need to fertilize your seedlings.

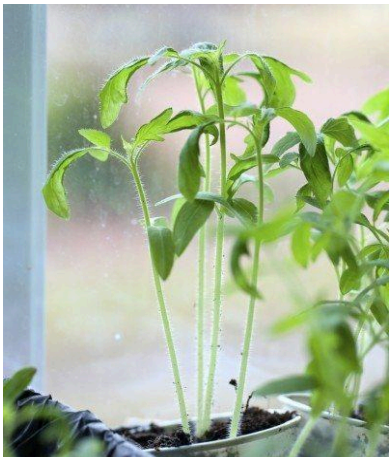
Growth medium for indoor seed starting must be light and porous, to hold adequate water and air, and drain well. You can use well-aged leaf mould and/or compost, or a purchased seedling mix, but NOT soil from the garden or purchased garden/top soil. These are too heavy and compact for good drainage and seedlings can rot.

2. Light:

Windowsills usually don't provide sufficient light; note the log scale of this figure. Windowsills and overhead lights provide about ten times less light than you would find outside even in deep shade, and about a HUNDRED times less light than full sun conditions outside.



If your seedlings look like this (called "etiolated": tall and spindly, possibly leaning towards light source), they are not getting enough light (and may also be too crowded in their pots). These seedlings will struggle--the stems may break or rot, and they are using resources to grow upwards, to get more light, instead of to build healthy strong photosynthetic (green) tissues. Our eyes adjust to different light levels, making it hard for us to tell if it is bright enough for plants.



If you want to provide supplemental light to avoid etiolation, you need fluorescent or LED lights with adjustable height. Fluorescent lights should be lowered almost on top of your plants, just a few inches above. LED lights can be 5-8 inches above. Multiple fixtures may be necessary. Incandescent light bulbs generate a lot of heat and may be a fire risk, so are not recommended. You can get creative (shop lights with fluorescent tubes are not that $$$) BUT use caution and common sense. Lights can be put on a timer, BUT see later where we talk

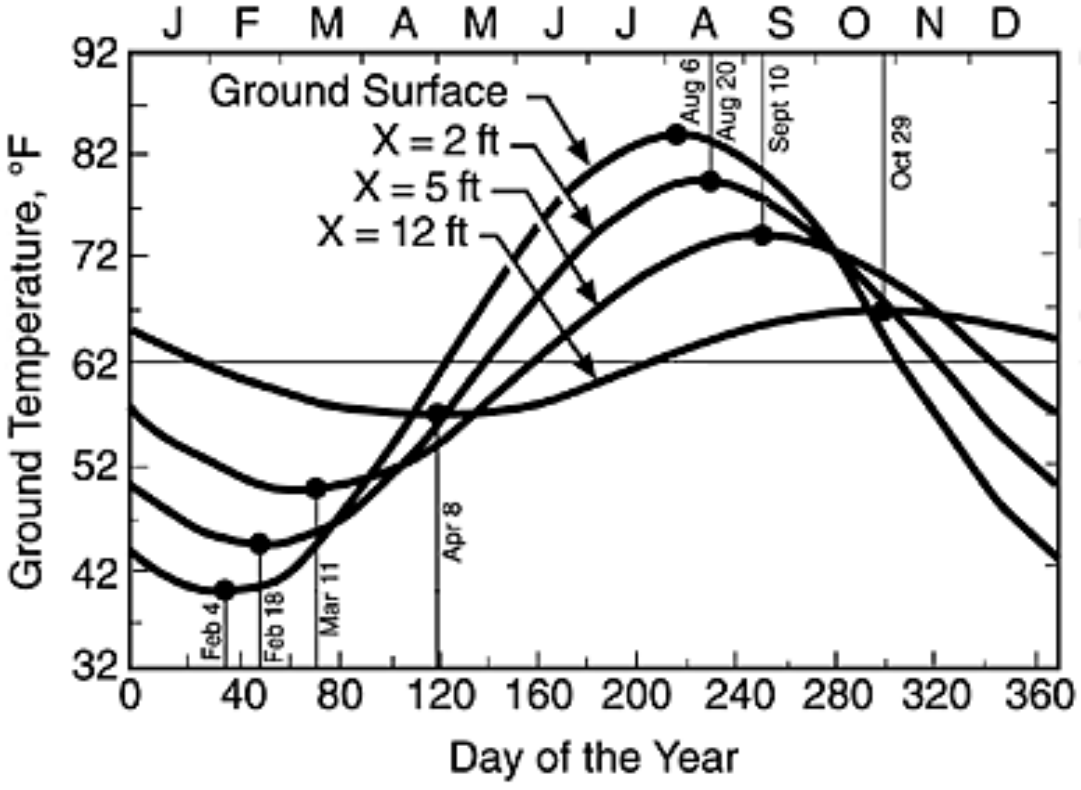
about how plants respond to day length.
(DEMO, my not-too-$$$ light set-up, using shop lights and wire shelf unit).

2. Heat:

- Fastest germination, and highest rate, occurs at the optimal germination temperature of each seed type, (from www.growgreatvegetables.com/plantinggrowing/germination/):

number of days to seedling emergence at each temperature:									
crop	32°F	41°F	50°F	59°F	68°F	77°F	86°F	95°F	104°F
carrots	0	51	17	10	7	6	6	9	0
eggplant	0	0	0	0	13	8	5	0	0
lettuce	49	15	7	4	3	2	3	0	0
parsley	0	0	29	17	14	13	12	0	0
peppers	0	0	0	25	13	8	8	9	0
radish	0	29	11	6	4	4	3	3	0
spinach	63	23	12	7	6	5	6	0	0
tomatoes	0	0	43	14	8	6	6	9	0

- Germination of older and/or improperly stored seeds may be even lower/slower
- Why these optimum temperatures, when they don't match ideal growing temperatures? Because seeds 'want' to germinate near the soil surface at the height of summer, when soil is quite warm--not too deep, too early, or too late in the year, all of which will prevent seedling success. (this graph's data is from somewhere in Virginia, X=depth).

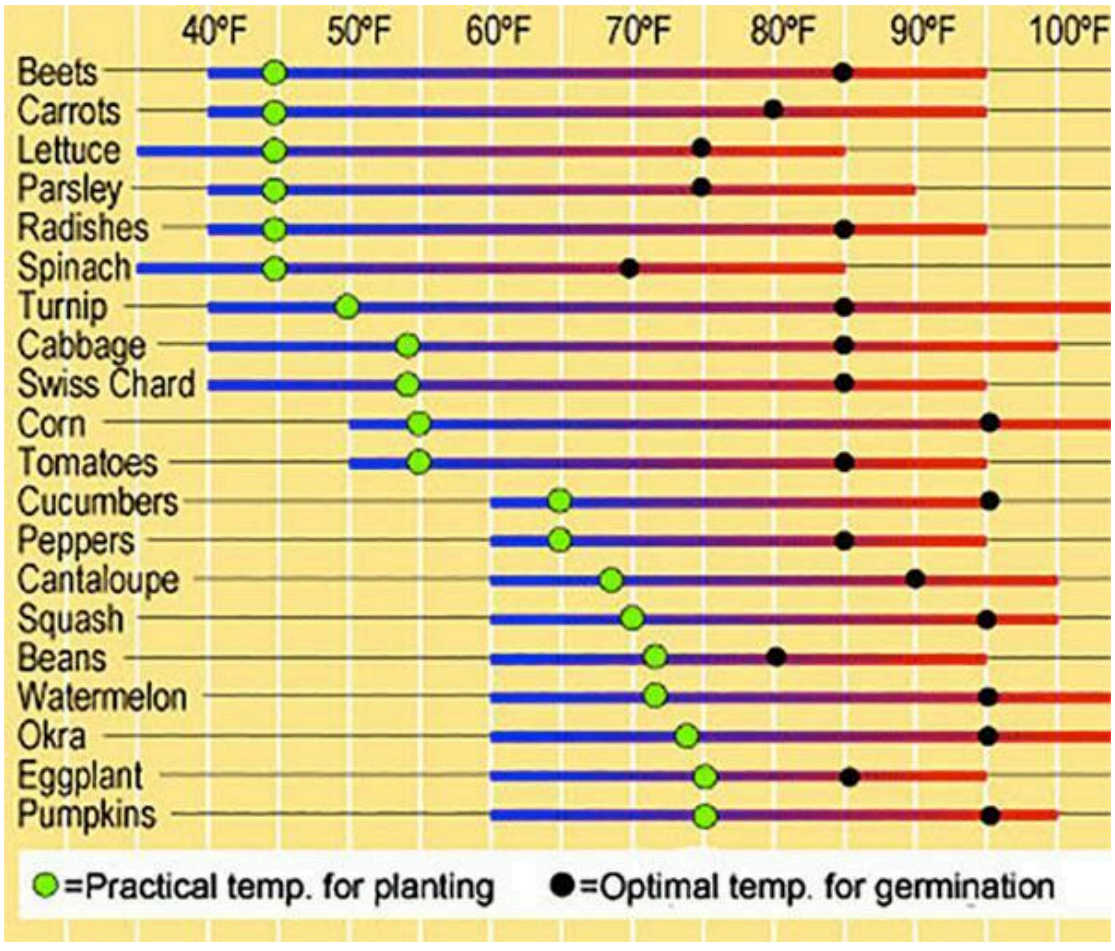


- Therefore, sometimes it is worth it to start seeds inside.
- This can also be done only to get the seeds to germinate, followed by immediate planting outside (e.g. peas, radish)
- Alternatively, may be done to get a head start on growth inside (e.g. peppers, tomatoes).

For example, radishes can grow outside as early as 2-3 weeks before the last spring frost, with average soil temperatures as low as 55˚F, but their optimum germination temperature is 85˚F! By the time soils are this warm, radishes are likely to grow tough and peppery, and bolt (form flower buds) without making nice radishes to eat. To get around this, seed can be germinated inside, in a tupperware or baggie without soil (DEMO—radish seeds started inside without growth medium for immediate planting outside). Radishes also grow well in fall to early winter, when air temperatures drop below 65 ˚F—but hot dry late summer conditions might not allow for good germination, so similar indoor germination is a good option then too.

In contrast to radish and peas, tomatoes, peppers and eggplants, and many others, need warm temperatures for both germination and good growth, and their seedlings grow slowly at first (these are actually perennials at lower latitudes). If you have space and lights, you can get a better chance for a summer harvest by starting them inside in late Feb. or early March, and transplanting them outside in mid- to late-May.

The location of the black dot in this chart indicates the optimum germination temperatures (per UC Davis). The green dot shows a "realistic" compromise between good temperatures for germination and subsequent growth in the garden. For practical purposes, you can start planting or tran-splanting as soon as your garden soil reaches this temperature.



If you don't have a soil thermometer, you are welcome to borrow one of mine or just ask me what the temp is in my yard (specify north or south facing, full sun or part shade, etc.).

4. Water and nutrients:

https://www.wsscwater.com/water-quality--stewardship/water-quality/water-quality-faqs.html

Local water is treated with chlorine. This can accumulate in the soils of houseplants, although letting the water sit overnight before using allows the chlorine to degas. This is less of an issue for seedlings that will be planted outside within a few weeks.

I tend to use purchased seed-starting or potting soil for my seedlings, and these usually contain fertilizer already. If you want to use leaf mould, peat moss, vermiculite, and/or other growth media that do not contain much in the way of mineral nutrients, and you are growing seedlings inside for longer than ~1 week, you will need to apply fertilizer. For small seedlings, I suggest any liquid fertilizer to about half-strength or weaker, because the new stems and leaves can be damaged by high concentrations of nitrogen.

Damping-off:
To keep soil moist while seeds are getting ready to germinate, you might want to cover with a clear plastic dome, or with saran wrap or a trash bag. As soon as seedlings emerge from the soil, however, you should remove these coverings (except in specific cases, such as grafting plants, or if the dome is a fancy vented one). High humidity can encourage damping-off (which is a fatal rotting of the stem caused by 'water-molds', fungi in the group Oomycetes). If you have had problems with damping off, using completely new growth medium and new pots, and/or sterilizing your growth medium and containers in the microwave, might help. Mostly, allow the growth medium to drain well and for the surface to dry out slightly before watering again, and reduce watering overall.

Problems with fungus gnats?
Bacillus thuringensis, "Bt", the ingredient in the treatment for mosquitoes in our rainbarrels as well as in several organic-approved garden insecticide, is now labelled for use in controlling fungus gnats. The liquid formulations of Bt sometimes have an unpleasant odor, but I've had success in scattering the granulated product on the surface of my growth medium. Watering gradually adds the Bt to the growth medium. NOTE–only Bacillus thuringensis subspecies isreaelensis controls fungus gnats: "The most commonly used strain of Bt (kurstaki strain) will kill only leaf– and needle-feeding caterpillars, but **there is another (israelensis strain, or Bti) used to control certain types of fly larvae, including black flies, fungus gnats and larvae of mosquitoes**."

5. Other germination requirements:

Scarification (DEMO, nasturtium seeds and sandpaper)

Stratification (DEMO, seeds in fridge with water and sterilized sand or paper towels)

6. HARDENING-OFF, From https://gg.memberclicks.net/hardening-off-plant-starts

“Hardening off” (demo on porch) is the process of moving plants outdoors for a portion of the day to gradually introduce them to direct sunlight, dry air, and cold nights. Below are step-by-step instructions given by Norma Rossel, Quality Assurance Manager for Johnny's Selected Seeds.

1. Harden off gradually, so that seedlings become accustomed to strong sunlight, cool nights and less-frequent watering over a 7-10 day period.
2. On a mild day, start with 2-3 hours of sun in a sheltered location.
3. Protect seedlings from strong sun, wind, hard rain and cool temperatures.
4. Increase exposure to sunlight a few additional hours at a time and gradually reduce frequency of watering, but do not allow seedlings to wilt. Avoid fertilizing.
5. Keep an eye on the weather and listen to the low temperature prediction. If temperatures below the crop's minimum are forecast, bring the plants indoors.
6. Know the relative hardiness of various crops. Onions and brassicas are hardy and can take temperatures in the 40's. After they are well hardened off, light frosts won't hurt them. Warm-season crops such as eggplants, melons and cucumbers prefer warm nights, at least 60° F. They can't stand below-freezing temperatures, even after hardening off.
7. Gradually increase exposure to cold.
8. After transplanting to the garden, use a weak fertilizer solution to get transplants growing again and to help avoid transplant shock. Be sure to water plants after hardening them off.

Hardy plants, can be hardened off when the outside temperature is consistently above 40° F. Half-Hardy plants may be hardened off at 45° F.

Recommended Minimum Temperatures for hardening off		
Hardy	40° F.	Broccoli, Brussels sprouts, kohlrabi, cabbage, onions, leeks, parsley
Half-Hardy	45° F.	Celery, Chinese cabbage, lettuce, endive
Tender	50° F.	Squash, pumpkin, sweet corn
	60° F.	Cucumber, muskmelon
	65° F.	Basil, tomatoes, peppers

7. Planning: see separate handouts about when to start seeds.

FROST DATES: Hyattsville's average last spring frost is ~April 9th, and average first fall frost is ~ Oct 26th (see page 4). These averages may change over time (climate change).

Many seed starting schedules are based on number of weeks before the last spring frost:

10 weeks before last frost	8 wks	6 wks	4 wks	ave last frost
Jan 29	Feb 12	Feb 26	March 12	April 9

Brief seed starting schedule (take a handout with more complete schedules if desired, or follow links on next page) THESE VARY among gardeners:

When to start (weeks before last spring frost)	What to start
11 weeks	heliotrope, candytuft, primula, leek, viola, snapdragon, early greens (to be planted out in the cold frame or greenhouse beds)
10 weeks	delphinium, matricaria, onion, parsley, Greek oregano, impatiens, rudbeckia, early broccoli
9 weeks	pepper, coleus, shallot, eggplant, cherry tomato
8 weeks	tomato, alyssum, cleome, salvia horminum
7 weeks	ageratum, zinnia, more lettuce, radicchio
6 weeks	bachelor's buttons, agastache, aster, basil, marigold, sweet pea, calendula
5 weeks	sanvitalia, cabbage, convolvulus, nicotiana, lavatera, nigella, phlox, phacelia
4 weeks	morning glory, nasturtium, melon, cucumber, squash

Some plants (once they've been hardened off) can withstand a 'light' frost to 32˚ (e.g. broccoli, cabbage, parsley), but can't survive a 'hard' frost down to 28˚. See last page for expected hard frost dates, etc.

Links for other handouts:

Johnny's Selected Seeds seed-starting date calculator:

https://www.johnnyseeds.com/growers-library/seed-planting-schedule-calculator.html

Links to Johnny's fall and winter crop planting calendars and succession planting schedules:

https://www.johnnyseeds.com/growers-library/online-tools-calculators.html
(scroll down to "Plant" section)

A way to garden seed starting calendar:

https://awaytogarden.com/when-to-start-seeds-calculator/

Day length and flowering/table of photoperiod for various plants:

https://www.extension.purdue.edu/extmedia/HO/HO-249-W.pdf

To see a graph or chart of hours of daylight per day for this calendar year, visit
https://www.timeanddate.com/sun/@7258330
or
https://aa.usno.navy.mil/data/Dur_OneYear Hyattsville is latitude 38.96 and longitude -76.95

Duration of Daylight/Darkness Table for One Year

Duration of Daylight for the Year 2023
Hyattsville, MD
N 38° 58', W 76° 57'
Zone: 5.0 hours West of Greenwich

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	9:30	10:15	11:20	12:38	13:50	14:43	14:51	14:11	13:02	11:47	10:32	9:39
2	9:30	10:17	11:22	12:41	13:52	14:44	14:51	14:09	13:00	11:45	10:30	9:37
3	9:31	10:19	11:25	12:44	13:55	14:45	14:50	14:07	12:57	11:42	10:28	9:36
4	9:32	10:21	11:27	12:46	13:57	14:46	14:49	14:05	12:55	11:40	10:26	9:35
5	9:33	10:23	11:30	12:49	13:59	14:47	14:49	14:03	12:52	11:37	10:24	9:34
6	9:34	10:25	11:32	12:51	14:01	14:48	14:48	14:01	12:50	11:35	10:22	9:33
7	9:35	10:27	11:35	12:54	14:03	14:49	14:47	13:59	12:47	11:32	10:19	9:32
8	9:36	10:30	11:37	12:56	14:05	14:50	14:46	13:57	12:45	11:30	10:17	9:32
9	9:37	10:32	11:40	12:59	14:07	14:50	14:45	13:55	12:42	11:27	10:15	9:31
10	9:38	10:34	11:42	13:01	14:09	14:51	14:44	13:53	12:40	11:25	10:13	9:30
11	9:39	10:36	11:45	13:03	14:11	14:51	14:43	13:50	12:37	11:22	10:11	9:29
12	9:40	10:39	11:48	13:06	14:13	14:52	14:42	13:48	12:35	11:20	10:09	9:29
13	9:42	10:41	11:50	13:08	14:15	14:53	14:41	13:46	12:32	11:17	10:07	9:28
14	9:43	10:43	11:53	13:11	14:16	14:53	14:39	13:44	12:30	11:15	10:05	9:28
15	9:44	10:46	11:55	13:13	14:18	14:53	14:38	13:42	12:27	11:12	10:04	9:27
16	9:46	10:48	11:58	13:16	14:20	14:54	14:37	13:40	12:25	11:10	10:02	9:27
17	9:47	10:50	12:00	13:18	14:22	14:54	14:36	13:37	12:22	11:08	10:00	9:27
18	9:49	10:53	12:03	13:20	14:23	14:54	14:34	13:35	12:20	11:05	9:58	9:26
19	9:51	10:55	12:05	13:23	14:25	14:54	14:33	13:33	12:17	11:03	9:56	9:26
20	9:52	10:58	12:08	13:25	14:27	14:54	14:31	13:30	12:15	11:00	9:55	9:26
21	9:54	11:00	12:11	13:28	14:28	14:54	14:30	13:28	12:12	10:58	9:53	9:26
22	9:56	11:02	12:13	13:30	14:30	14:54	14:28	13:26	12:10	10:56	9:51	9:26
23	9:57	11:05	12:16	13:32	14:31	14:54	14:27	13:23	12:07	10:53	9:50	9:26
24	9:59	11:07	12:18	13:35	14:33	14:54	14:25	13:21	12:05	10:51	9:48	9:26
25	10:01	11:10	12:21	13:37	14:34	14:54	14:23	13:19	12:02	10:48	9:47	9:26
26	10:03	11:12	12:23	13:39	14:36	14:54	14:22	13:16	12:00	10:46	9:45	9:27
27	10:05	11:15	12:26	13:41	14:37	14:53	14:20	13:14	11:57	10:44	9:44	9:27
28	10:07	11:17	12:28	13:44	14:38	14:53	14:18	13:12	11:55	10:41	9:42	9:27
29	10:08		12:31	13:46	14:40	14:52	14:16	13:09	11:52	10:39	9:41	9:28
30	10:10		12:33	13:48	14:41	14:52	14:15	13:07	11:50	10:37	9:40	9:28
31	10:12		12:36		14:42		14:13	13:04		10:35		9:29

First and last frost dates for Hyattsville: from https://garden.org/apps/frost-dates/. The percentage values (%) indicate the likelihood of this temperature occurring after this date (spring) or before this date (fall). 50% marks the average last spring and average first fall frost dates.

In the Spring									
Likelihood:	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**
Last 16°F	11-Mar	4-Mar	26-Feb	22-Feb	18-Feb	13-Feb	9-Feb	3-Feb	27-Jan
Last 20°F	23-Mar	16-Mar	11-Mar	6-Mar	2-Mar	26-Feb	22-Feb	17-Feb	10-Feb
Last 24°F	28-Mar	24-Mar	21-Mar	18-Mar	16-Mar	14-Mar	11-Mar	8-Mar	4-Mar
Last 28°F	11-Apr	6-Apr	3-Apr	31-Mar	28-Mar	26-Mar	23-Mar	20-Mar	15-Mar
Last 32°F	20-Apr	16-Apr	13-Apr	11-Apr	9-Apr	6-Apr	4-Apr	1-Apr	28-Mar
Last 36°F	7-May	3-May	30-Apr	27-Apr	24-Apr	22-Apr	19-Apr	16-Apr	11-Apr
In the Fall									
Likelihood:	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**
First 16°F	27-Nov	7-Dec	13-Dec	19-Dec	25-Dec	30-Dec	5-Jan	12-Jan	21-Jan
First 20°F	23-Nov	29-Nov	4-Dec	8-Dec	11-Dec	15-Dec	19-Dec	23-Dec	30-Dec
First 24°F	5-Nov	12-Nov	17-Nov	21-Nov	25-Nov	29-Nov	3-Dec	8-Dec	15-Dec
First 28°F	19-Oct	25-Oct	30-Oct	2-Nov	6-Nov	10-Nov	14-Nov	18-Nov	25-Nov
First 32°F	12-Oct	17-Oct	21-Oct	23-Oct	26-Oct	29-Oct	1-Nov	4-Nov	9-Nov
First 36°F	30-Sep	5-Oct	9-Oct	12-Oct	15-Oct	17-Oct	20-Oct	24-Oct	29-Oct

tomatoes need air temps > 55-60°F, usually don't occur until mid-to-late May