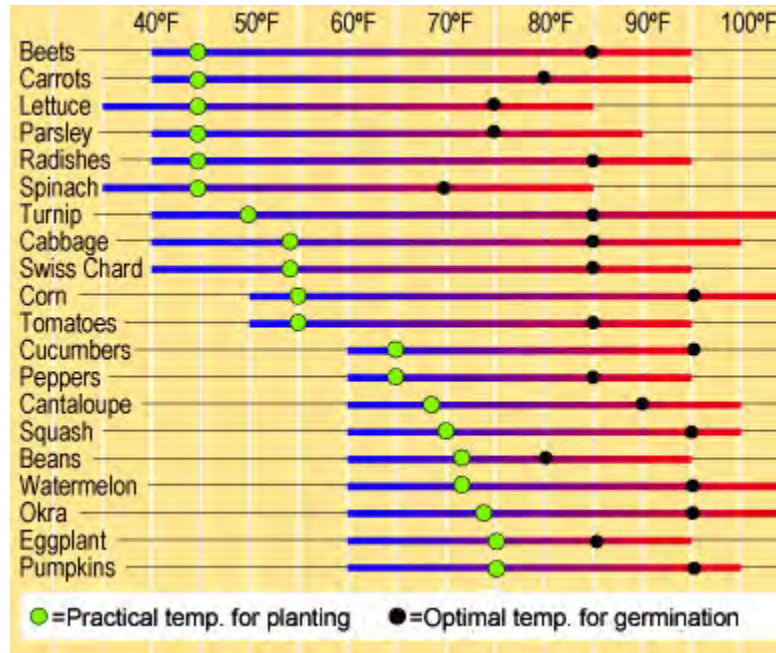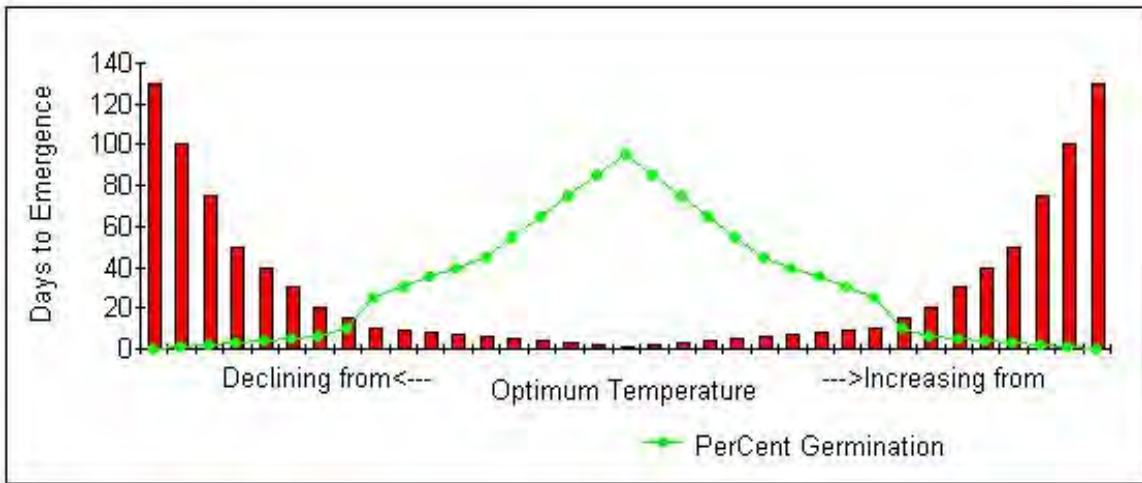# When is it Warm Enough to Plant?
(12/25/2016)

The effect of soil temperature on sown seeds.

The chart below displays the relationship between soil temperature, days to emergence, and the percentage of sown seeds to germinate:

For every species of seed, there is an optimal soil temperature for germination, and at that temperature, the maximum number of seeds will germinate and in less time than at any other temperature.

Percentage of Normal Vegetable Seedlings
Produced at Different Temperatures* **

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Numbers in ( ) are the days to seedling emergence. Number in red = optimal daytime soil temperature for maximum production in the shortest time.

Crops	32ºF	41ºF	50ºF	59ºF	68ºF	77ºF	86ºF	95ºF	104ºF
Asparagus	0	0	61(53)	80(24)	88(15)	95(10)	79(12)	37(19)	0
Beans, lima	0	0	1	52(31)	82(18)	90(7)	88(7)	2	0
Beans, snap	0	0	1	97(16)	90(11)	97(8)	47(6)	39(6)	0
Beets	0	53(42)	72(17)	88(10)	90(6)	97(5)	89(5)	35(5)	0
Cabbage	0	27	78(15)	93(9)	0(6)	99(5)	0(4)	0	0
Carrots	0	48(51)	93(17)	95(10)	96(7)	96(6)	95(6)	74(9)	0
Cauliflower	0	0	58(20)	60(10)	0(6)	63(5)	45(5)	0	0
Celery	0	72(41)	70(16)	40(12)	97(7)	65	0	0	0
Cucumber	0	0	0	95(13)	99(6)	99(4)	99(3)	99(3)	49
Eggplant	0	0	0	0	21(13)	53(8)	60(5)	0	0
Lettuce	98(49)	98(15)	98(7)	99(4)	99(3)	99(2)	12(3)	0	0
Muskmelon	0	0	0	0	38(8)	94(4)	90(3)	0	0
Okra	0	0	0	74(27)	89(17)	92(13)	88(7)	85(6)	35(7)
Onions	90(136)	98(31)	98(13)	98(7)	99(5)	97(4)	91(4)	73(13)	2
Parsley	0	0	63(29)	0(17)	69(14)	64(13)	50(12)	0	0
Parsnips	82(172)	87(57)	79(27)	85(19)	89(14)	77(15)	51(32)	1	0
Peas	0	89(36)	94(14)	93(9)	93(8)	94(6)	86(6)	0	0
Peppers	0	0	1	70(25)	96(13)	98(8)	95(8)	70(9)	0
Radish	0	42(29)	76(11)	97(6)	95(4)	97(4)	95(3)	0	0
Spinach	83(63)	96(23)	91(12)	82(7)	52(6)	28(5)	32(6)	0	0
Sweet Corn	0	0	47(22)	97(12)	97(7)	98(4)	91(4)	88(3)	10
Tomatoes	0	0	82(43)	98(14)	98(8)	97(6)	83(6)	46(9)	0
Turnips	1	14	79(5)	98(3)	99(2)	100(1)	99(1)	99(1)	88(3)
Watermelon	0	0	0	17	94(12)	90(5)	92(4)	96(3)	0

* The above data was taken from a report published in the mid-1980's. Author, affiliation, and publisher are not known.

** The above table was derived from experimental data. Certain logical inconsistencies exist due to crop failure or to bad batches of seed. They do not interfere with the overall interpretation.

As a general rule, seeds will germinate indoors where the soil temperature is held constant.

Some seeds require more than one year to germinate. Others, called multicycle germinators, require at least two cold stratification periods before germination; the hellebores are one example. Most members of the Ranunculus family require temperatures very close to the freezing point of the seed (~19ºF) for destruction of germination inhibitors. Some seed, like Cimicifuga require a long period of warm stratification before cold treatment. Other seed, like Myrrhis must be sown outdoors.

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SOIL TEMPERATURE CONDITION FOR VEGETABLE SEED GERMINATION

VEGETABLE	MIN. (°F)	RANGE (°F)	OPTIMUM (°F)	MAX (°F)	DAYS TO GERMINATION
ASPARAGUS[a]	50°	60° - 85°	75°	95°	21 - 30
BEAN[d]	60°	60° - 85°	80°	95°	7 - 14
BEAN LIMA[e]	60°	65° - 85°	85°	85°	10 - 14
BEET[b]	40°	50° - 85°	85°	95°	7 - 14
CABBAGE[a, b]	40°	45° - 95°	85°	100°	7 - 10
CARROT[b]	40°	45° - 85°	80°	95°	10 - 21
CAULIFLOWER[a, b]	40°	45° - 85°	80°	100°	3 - 10
CELERY[a]	40°	60° - 70°	70°	85°	14 - 21
CHARD SWISS[b]	50°	50° - 85°	85°	95°	7 - 14
CORN[d]	50°	60° - 95°	95°	105°	7 - 10
CUCUMBER[c, d]	60°	75° - 95°	95°	105°	7 - 10
EGGPLANT[c]	60°	40° - 80°	85°	95°	7 - 12
LETTUCE[a]	35°	40° - 80°	75°	85°	7 - 14
MUSKMELON[e]	60°	75° - 95°	90°	100°	7 - 10
OKRA[e]	60°	70° - 95°	95°	105°	8 - 12
ONION[a]	35°	50° - 95°	75°	95°	10 - 14
PARSLEY[b]	40°	50° - 85°	75°	90°	10 - 21
PARSNIP[b]	35°	50° - 70°	65°	85°	14 - 21
PEA[b]	40°	40° - 75°	75°	85°	8 - 10
PEPPER[c]	60°	65° - 95°	85°	95°	14 - 21
PUMPKIN[d]	60°	70° - 90°	95°	100°	7 - 10
RADISH[b]	40°	45° - 90°	95°	95°	3 - 7
SPINACH[b]	35°	45° - 75°	70°	85°	7 - 10
SQUASH[d]	60°	70° - 95°	95°	100°	9 - 12
TOMATO[c]	59°	60° - 85°	85°	95°	5 - 14
TURNIP[b]	40°	60° - 105°	85°	105°	6 - 7
WATERMELON[e]	60°	70° - 95°	95°	105°	7 - 10

[1]Compiled by J.F. Harrington, Dept. of Vegetable Crops, University of California, Davis.
[2]Daily fluctuation to 60° or lowers at night is essential

[a]Hardy vegetables to grow as transplants.
[b]Hardy vegetables for direct seeding.
[c]Tender vegetables to grow as transplants.
[d]Tender vegetables for direct seeding.
[e]Tender vegetables for direct seeding, 2 weeks after last frost.

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TEMPERATURES AND TIMES REQUIRED FOR GROWING PLANTS FOR FIELD TRANSPLANTING

Vegetable	Day[2] (°F)	Night (°F)	Time (weeks)
Asparagus	70° - 80°	65° - 70°	8 - 10
Broccoli	60° - 70°	50° - 60°	5 - 7
Brussels Sprouts	60° - 70°	50° - 60°	5 - 7
Cabbage	60° - 70°	50° - 60°	5 - 7
Cauliflower	60° - 70°	50° - 60°	5 - 7
Celery	65° - 75°	60° - 65°	10 - 12
Sweet Corn	70° - 75°	60° - 65°	3 - 4
Cucumber	70° - 75°	60° - 65°	3 - 4
Eggplant	70° - 80°	65° - 70°	6 - 8
Lettuce	70° - 80°	50° - 55°	5 - 7
Muskmelon	70° - 75°	60° - 65°	3 - 4
Onion	60° - 65°	55° - 60°	10 - 12
Pepper	65° - 75°	60° - 65°	6 - 8
Summer Squash	70° - 75°	60° - 65°	3 - 4
Tomato	70° - 75°	65° - 75°	5 - 7
Watermelon	70° - 80°	65° - 70°	3 - 4

For more info see: https://cals.arizona.edu/pubs/garden/mg/vegetable/temperature.html