

Seed Starting for Flower Gardening

A Scientific Approach

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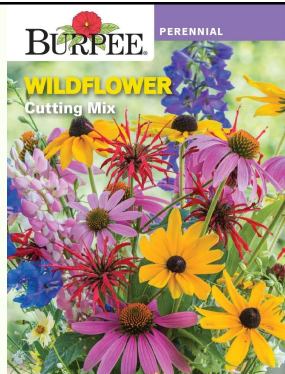
Why Start From Seed?

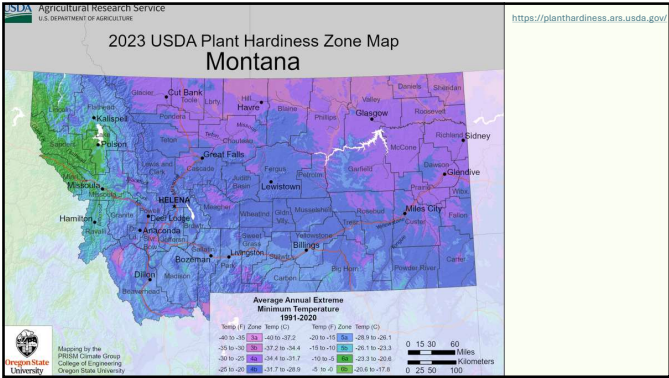
- Cost-effective
- Access to rare varieties
- Joy of planting in winter



Outline

- Seed basics
 - Timing
 - Media
- Caring for your seedlings
- Starting native seeds
- Troubleshooting
- Hardening off





Freeze / Frost Occurrence Data												
All probabilities in whole percent. See notes for probability level description. Indicates the probability of occurrence of threshold temperature is less than indicated probability.												
State And Station Name	T h r e e s e s o i d (F)	Spring (Date)			Fall (Date)			Freeze Free Period (Days)			P r o b a b i l i t y (4)	L e v e l
		Probability Level (1)			Probability Level (2)			Probability Level (3)				
		90	50	10	10	50	90	10	50	90		
Montana												
AUGUSTA	36 32 28	May26 May15 Apr25	Jun16 May27 May08	Jul06 Jun09 May21	Aug11 Sep02 Sep08	Aug29 Sep12 Sep19	Sep16 Sep22 Oct01	99 123 153	73 108 134	48 83 114	58 48 38	
LINCOLN RANGER STN	38 32 28	Jun28 Jun08 May08	Jul19 Jul03 Jun06	Aug08 Jul29 Jul04	Jul30 Aug03 Aug17	Aug09 Aug18 Sep02	Aug21 Sep03 Sep18	46 78 126	21 45 86	0 13 49	73 62 46	
HELENA AP	36 32 28	May19 May03 Apr16	Jun05 May19 Apr30	Jun22 Jun04 May15	Aug26 Sep06 Sep12	Sep08 Sep18 Sep28	Sep21 Sep29 Oct15	118 140 174	95 121 150	71 102 127	58 50 40	

<https://www.montana.edu/extension/mastgardener/linksandresources/frostfreezedata.html>

	Recommended Temperatures		
	Seed Germination (°F)	Growing Transplants (°F)	Number of weeks from seed to transplant
Begonia	70	65	12
Geranium	70-75	65	14-16
Impatiens	70	65	10-12
Marigold	70-80	65	7-8
Moss Rose	70	65	11
Petunia	70-80	50-55	12
Salvia	70	65	11
Zinnia	70-65	65	5-8

Notes: Minimum values are for seedling establishment and transplanting.

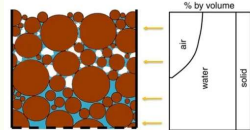
Supplies

- Trays
- Heating mat
- Grow light
- Media



Seed Starting Media: Pore Space

- Macro porosity
 - Field soil has less air-filled pores (AFP)
 - Small, fragile seedling roots die from hypoxia
 - ~20% AFP is ideal
- Micro porosity
 - Water holding capacity (WHC) is gained from micro pores
 1. Medium pores – readily available water
 2. Small pores – mild wilting occurs
 3. Very small pores – severe wilting occurs
 - High proportion of medium pores desired



Seed Starting Media: Considerations

- Ideally sterile
 - Prevents excessive growth of pathogens
- Peat or coir-based medias fit the bill
- Compost can be used up to 30-40% by volume
- Small particle size!

Media Requirements:

1. Support plants
2. Provide nutrients
3. Provide aeration (AFP)
4. Retain water (WHC)



Seed Starting Media: Types

• Peat Moss

- Harvested from bogs of sphagnum peat moss
- Becomes hydrophobic <40% water
- High WHC, high AFP



• Coconut coir

- Byproduct from coconut fruits
- Hydrophilic
- High WHC, high AFP
- Studies reported ≥ growth than in peat
- More expensive

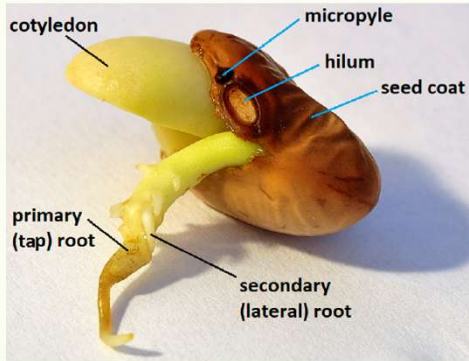


• Perlite

- Expanded volcanic glass
- High AFP, no WHC

• Vermiculite

- Micaceous mineral expanded by heat
- Good for top-sanding
- High WHC, high AFP



Caring for Seedlings Indoors

	Ideal Soil Temp (Germination)	Ideal Air Temp (Post-Emergence)	Examples
Warm-Season	75°F – 85°F	70°F – 75°F	Zinnia, Celosia, Cosmos, Sunflower, Marigolds
Cool-Season	60°F – 70°F	55°F – 65°F	Snapdragon, Stock, Sweet Pea, Bells of Ireland
General Average	72°F	68°F	Mixed bedding plants

Caring for Seedlings Indoors

Light

- Daily Light Integral (DLI) – total photons received in a 24-hr period
- Ideally $10-12 \text{ mol} \cdot \text{m}^{-2} \cdot \text{d}^{-1}$
- Use a light meter, or Photone App (free, accurate within 5-10%)
- If not enough light, increase hours

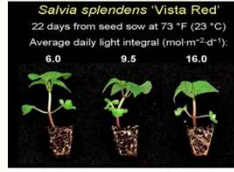


Figure 7. The effect of average daily light integral (DLI) on rooting of 'Vista Red' salvia (*Salvia splendens*). Plants were grown for 22 days after seed sow at 73 °F (23 °C) and under an average DLI of 6.0, 9.5, or 16.0 $\text{mol m}^{-2} \text{d}^{-1}$. Photo courtesy Lee Ann Moccaldi, Michigan State University.

Caring for Seedlings Indoors

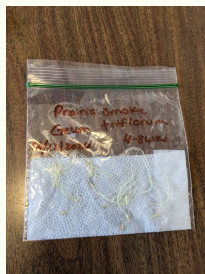
Humidity

- Germination:
 - Ideally ~90%
- Seedlings:
 - Ideally ~70%
 - Open vents or prop humidity dome after germination
 - Complete removal too rapidly can desiccate seedlings



Native Flowers From Seed

- Some require special treatment
- **Scarification**
 - Nicking the seed coat to allow water and air inside
 - Sandpaper, knife, or file
- **Stratification**
 - Seed pretreatment to "overwinter"
 - **Cold** – 35 - 40°F
 - **Moist** – damp paper towel in Ziploc bag
 - **Time period** – a few days, weeks, months



<https://invasiveplants.org/wp-content/uploads/2022/03/MNPS-Wild-Seed-Germination-Paper-draft.pdf>

[illegible]

D *Abronia fragrans* (Fragrant Sand-verbena) - Nyctaginaceae

In fall, scarify (acid 10 minutes or sandpaper), soak 12-24 hours, sow in situ. Cover the seeds to depth.
The seeds require at least 2 months of cold moist treatment.
Seeds may take a few years to germinate.

E *Achillea millefolium* (Common Yarrow) - Asteraceae
Dry store the seeds at 70° over the winter. Sow, cover very lightly. Expose to 70-77° in the day and 60° at night. These temperatures are goals. The warm daytime temperature is the most important one.

<https://frontrange.wildones.org/wp-content/images/sites/105/2022/09/Germination-Guide-22-latest-copy.pdf>

Damping off

- Rotting stems at or near the soil line
- Can also happen prior to germination
- Caused by variety of pathogens
- To prevent:
 - Sanitize seed trays between uses
 - Use proper soil medium
 - Proper seeding depth and soil temp
 - Fungicide use in extreme cases



Overwatering

- Yellowing, wilting, or drooping leaves
- To prevent:
 - Decrease watering
 - Never use trays/pots without drainage holes
 - Use bottom-watering
 - Consider using “self-watering” trays



Overcoming Common Challenges

Etiolation

- Stem elongation
- To prevent:
 - Increase light intensity and/or duration
 - Use a gentle fan to increase stem strength



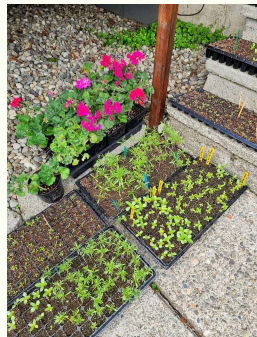
Seedling Diagnostic Tree

- Seedlings collapsed at the soil line.
 - Is the soil wet/sodden? **DAMPING OFF** (Fungal infection).
Fix: Discard affected cells. Increase airflow (fan), let the surface dry.
 - Is the soil too dry? **DESICCATION** (Under-watering).
Fix: Immediately bottom-water.
- Stems are incredibly tall, pale, and falling over.
 - Are the lights more than 3 inches away? **ETIOLATION** (Not enough light).
Fix: Lower lights. Run a gentle fan to build stem strength.
- Leaves are turning pale or yellowing.
 - Are the first "true leaves" showing? **NITROGEN DEPLETION**.
Fix: The seed's energy is gone. Begin feeding with 1/4 strength liquid fertilizer.
 - Is the soil constantly saturated? **HYPOXIA** (Lack of oxygen- overwatering).
Fix: Roots cannot absorb nutrients without oxygen. Stop watering!
- Undersides of leaves have crusty, blister-like bumps.
 - Is the dome still on / Is airflow stagnant? **EDEMA** (Ruptured cells).
Fix: Prop the dome open or remove it. Add an oscillating fan to increase transpiration.
- Seedlings stop growing; tiny black flies are present.
 - Is the soil surface always damp? **FUNGUS GNATS** (Larvae eating roots).
Fix: Let the top inch of soil dry out. Use yellow sticky traps for adults. Use BTI drench for severe infestations.



Hardening Off

- Gradually transitioning a plant to the outdoor conditions of fluctuating spring temps, wind, and sun exposure
- Process takes 7-14 days
- Goal is to slow growth of the plants to allow them to adjust to changing weather conditions



Hardening Off

- Thigmomorphogenesis –
Plant growth alters to shorter, stockier stems due to touch, wind, or rain



The image shows two groups of small green plants in orange pots. The group on the left, labeled 'Untouched', consists of three plants with tall, thin, and slightly curved stems. The group on the right, labeled 'Touched', consists of three plants with much shorter, thicker, and more upright stems, demonstrating the effect of thigmomorphogenesis.

Hardening Off

Phase	Duration	Environment	Goal
Days 1–2	1–2 Hours	Deep shade; fully sheltered from wind	Initial UV exposure & gas exchange adjustment
Days 3–5	3–5 Hours	Dappled sunlight (morning sun only); moderate breeze	Trigger initial thigmomorphogenesis
Days 6–8	6–10 Hours	Partial to full sun; open exposure	Accelerate wax biosynthesis & lignification
Days 9–10	24 Hours	Full sun; leave outdoors overnight	Final temp acclimation

Transplanting After Hardening Off

- Transplant on a cloudy day or close to dawn or dusk
- Plant at same depth as in container
- Water the plant thoroughly – provides water and settles soil



A close-up photograph showing a person's hand holding a small green plant with a root ball. The plant is being placed into a hole that has been dug in the soil. A shovel is visible in the background, and other plants are in the background.