Why do Some Perennials Survive the Winter, and Others Don’t?

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Hardiness variables: temperature

- acclimation
- deacclimation
- date of freeze
- freeze duration
- cycling temperatures (fall, spring)
- rate of thawing
Hardiness variables: culture and crop

- established (older) vs new plants
- moisture/watering
- fertility effects
- species/ cultivar
  - lowest temperature tolerated
Hardiness variables

acclimation-- effects

• **fall**: more cold (earlier, deeper) may harden less hardy species, more hardy species may not benefit
  – as little as 2 wks of cold (<40°F) may help

• **winter**: less hardy: more than 2 days just below freezing (28°F/-2°C), prior to lower temperatures, may be harmful
Hardiness variables

deacclimation-- effects

• warm (55-65F/12-18C) for as little as 3 to 5 days midwinter can deacclimate
• back down to 39-41F (4-5C) at night doesn’t appear to help
• no differences 34 F (1C), 40F (4.5C) and 28-41F (-2 to 5C)
• more effect at lower subsequent freezing temperatures, e.g.
  – 18F/-8C and below Sedum, Shasta Daisy
  – 12F/-11C and below Salvia
Hardiness variables

**date of freezing**

- plants not hardened by early fall
- some may be hardened sufficiently by November (depends on other temperature variables)
- most have maximum hardiness by December or January
- may begin to lose hardiness (deacclimation) by late February
Hardiness variables

**freeze duration**

- longer durations, especially at lower temperatures, may be more harmful
- less regrowth from 24-48 hours at each low temperature vs 1/2 or 2 hrs
- no differences between 1/2 and 2 hrs
Hardiness variables

cycling temperatures

- fluctuating **above and below** freezing
  - cycle=2 hrs each temp., near freezing
- hardy species: cycling may have no benefit
- less hardy species: more than one cycle may be harmful
  - more likely in late winter, early spring
Hardiness variables

cycling temperature ranges

- cycling 26/38F (-3/3C), or below freezing, may result in more hardiness than constant 38-40F
- more injury is likely at wide cycling such as 18/47F (-8/8C)
- few differences among 1,2,3 cycles
- duration at each temperature (1 vs 3 days) is not as crucial as temperature
Dianthus ‘Kahori’ Acclimation studies—Cycling between 27F (-3C) and 23F (-5C), over 2 weeks

4 cycles

no cycles

-5C (23F)  -8C (18F)  -11C (12F)  -14C (7F)
Overwintering Materials and Methods

affects in particular:
- lowest exposure
- temperature cycling
- duration of cold

snow: best protection, usually least reliable

View from Trapp Lodge, Vermont
using geotextile “fleece”

- Few differences in survival (zone 5) for many species with one or two layers, with/ without white poly over
  - air exchange lessens temp. rise under
  - air exchange lessens disease under
  - porous so can water through
Overwintering Materials: “sandwich”

1. Cover with poly
2. Straw, fluffed
3. White poly on top

Cold climates, maximum protection, least temperature fluctuation
Container soil temperatures

- often follow air temperatures closely
  - if small, space around, within a day
  - if larger, pot-pot-pot, within 2-3 days
- even 2” snow, mulch provides moderation
  - especially during extremes when frozen
- if on nursery ground cloth fabric:
  - pots cool faster in fall
  - pots warm faster in spring
  - due to cloth affect on ground heat
geotextile cover pot temperatures, 1/18-1/20

<table>
<thead>
<tr>
<th>Time</th>
<th>temp. F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1am</td>
<td>2 fleece</td>
</tr>
<tr>
<td>1pm</td>
<td>2 fleece/poly</td>
</tr>
<tr>
<td>1am</td>
<td>grnd cloth/2 fleece</td>
</tr>
</tbody>
</table>

- **Red** line: fleece
- **Orange** line: 2 fleece/poly
- **Yellow** line: 2 fleece
- **Blue** line: grnd cloth/2 fleece
pot temperatures under covers
1/15-1/17

-10
-5
0
5
10
15
20
25
30
35
12am
12pm
12am
12pm
12am
12pm
12am
temp. F

open
white poly
microfoam/poly
poly/straw/poly
spring pot temperatures under covers

4/2

temp. F

open white poly microfoam/poly poly/straw/poly foam/no poly

6am 12pm 6pm
When to cover?

• more crucial when to *uncover*, than cover
• usually cover late, prior to snowfall
  – early Nov. in zone 4, late Nov. in zone 6
• cut back prior to cover
  – hedge shear, weed whacker, similar
  – watered, mouse bait
When to uncover?

- uncover as soon as snow goes
  - early Mar. in zone 6, late Mar. in zone 4
  - plants will grow, less damage if uncovered and hardened
- may use frost fabric, one layer fleece as needed
  - retail, reduce injury
Overwintering Materials: hoop house

- all climates
- poly layers depend on climate
- species that rot under covers
- ability to control growth in spring with minimal climate control
- must have good ventilation to avoid high temperatures in winter
Hardiness variables

rate of thawing

- from target freezing temperatures
  - 28, 23, 18, 12, 7 °F (-2, -5, -8, -11, -14 °C)
- rapid thaw--direct to 39-41F/4-5C greenhouse
- slow thaw--allow soil to return to 28F (-2 C), hold, then to greenhouse
- often rapid thaw had better growth, or no difference
Hardiness variables—crop and culture

older vs newer plants

- age reflection of vigor
- often more vigorous are more hardy, survive at lower temperatures, than older/rootbound or recent plugs
  - one-year old plants usually survive better than two-year old
  - Fall-potted, poorly-rooted often fail to survive low temperatures
Hardiness variables—crop and culture

**fertility effects**

- Increased N levels and durations increased growth prior to, and after, freezing
  - Best regrowth usually from Controlled Release Fertilizer

- No effect on freezing regrowth (hardiness survival), at all freezing temperatures, from levels or durations
  - Different from woody plants
Fertility dates -- Karmina geranium

end: Sep 1

Oct 1

weekly 20-10-20
Fertility types--Karmina geranium

20-10-20
end 10/1

Osmocote
15-9-9,
5-6 mo.

28F  21F  18F  12F  7F
Hardiness variables—crop and culture

moisture/watering effects

• On cultivars studied (6 genera/cultivars), soil moisture caused no differences in hardiness:
  – wet 40%+ moisture, dry 10% or less
  – plants were watered well prior to freezing, if not—dry plants with more damage?

• moisture did affect growth
Hardiness variables—crop and culture species, cultivars

- controlled freezing studies yearly
  - 6-8 cultivars (6 plants each per treatment)
  - 4-in. pots, greenhouse 32-42°F (0-4°C)
  - 2 days prior to freeze, 28°F
  - remove plants at 28,23,18,12,7 °F (-2,-5,-8,-11,-14 °C)
  - 2hr. avg. at each temp.
bottom of freezer, 
7F (-14C)

top layer of freezer, 
28F (-24C), 23F (-5C)
Controlled Freezing Studies

*Heuchera*
‘Raspberry Regal’
Controlled Freezing Studies

Echinacea ‘Pow Wow Wild Berry’

Freeze Feb. 26

-2C (28F)

-5C (23F)

-8C (18F)

-11C (12F)

-14C (7F)
Global Warming mums

Zones (5)6-8

Sinclair Adam, Jr. breeder
Conclusions, to date

- Avoid low temperatures (below 28 to 23F/ -2 to -5C) early (before December) or late (after mid February), if possible
- Avoid widely cycling temperatures above and below freezing (such as 18/47F (-8/8C), especially early and late in the season
...conclusions

• The less time at very cold temperatures for less hardy species, the better (less than 24 hours, even below 28 to 23°F/ -2 to -5°C)

• The sooner very low soil temperatures can be warmed, the better
...conclusions

- Ideal temperatures to hold plants are 28 to 41°F (-2 to 5°C)
- Try to avoid temperatures on warm days reaching (55-65°F/12-18°C) for 3 days or more (less is better, particularly for less hardy species)
...conclusions

• Keep plants well-fertilized in fall
• Keep plants watered as appropriate to the species
• Poorly rooted (potted too soon prior to cold), or overly rooted/rootbound, plants are more susceptible to cold
• Group species/cultivars by hardiness
Appreciation is expressed to the following plant introduction firms and growers

- Aris Horticulture
- Ball Horticulture
- Blooms of Bressingham
- Danzinger
- Emerald Coast Growers
- Hoffman Nursery
- Kurt Bluemel
- McGregor Plants
- Plant Haven
- Plants Nouveau
- Pleasant View Gardens (PW/PS)
- Terra Nova
- Walter’s Gardens
Appreciation is expressed to many regional nurseries for support or plants, including:

- Creek Hill
- Dunvegan
- Full Circle Gardens
- North Creek
- Quansett
- Sunny Border
Appreciation is expressed to the following for assistance with funding

- New England Grows
- Northeast Greenhouse Conference
- New Hampshire Horticulture Endowment
- Perennial Plant Association
- USDA Risk Management Agency
- Vt. Agr. Expmt. Station
for more information...

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