Plant Winter Injury and Overwintering Options

Carey Grable

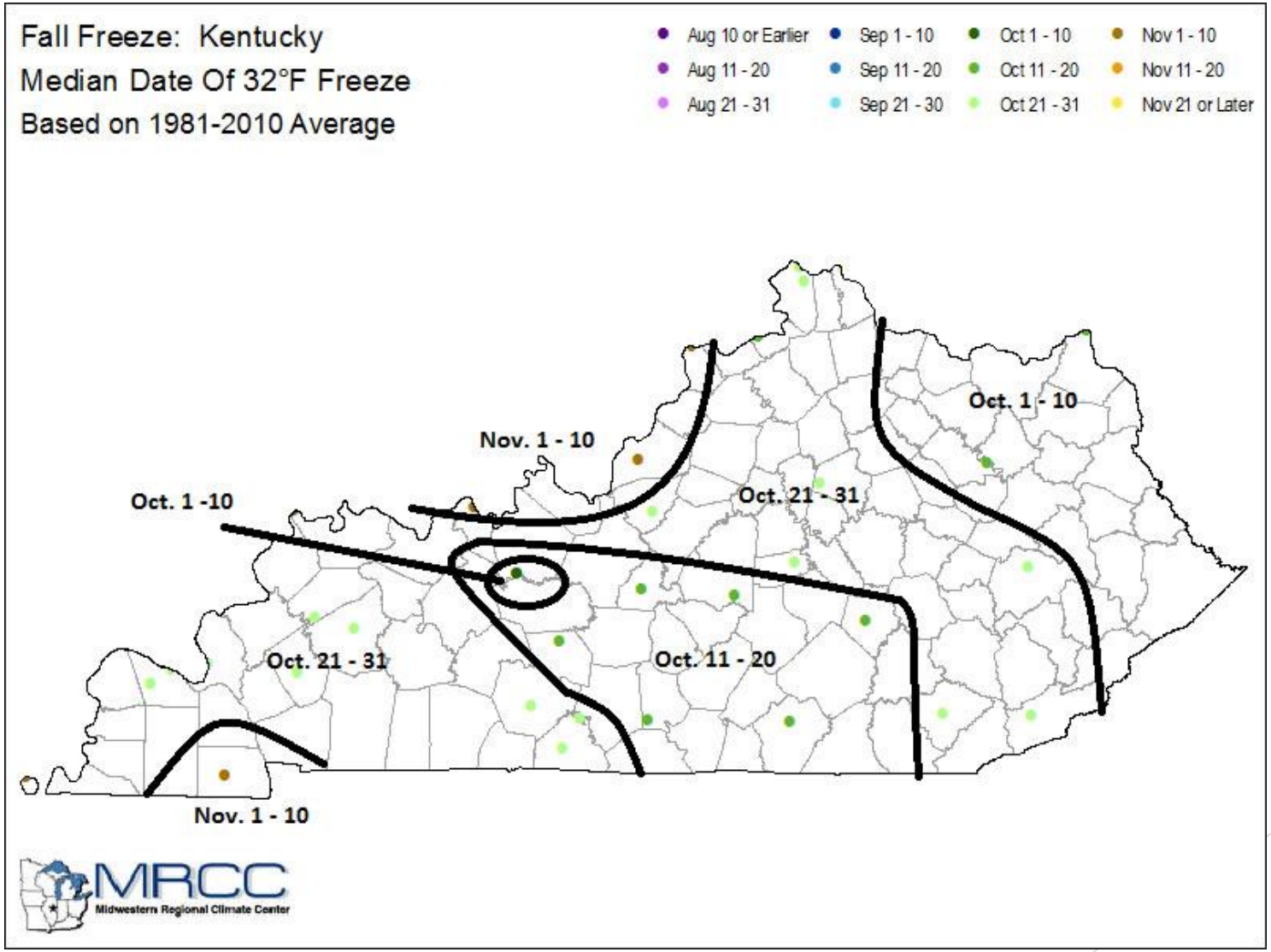
UK Department of Horticulture

KADF
KENTUCKY AGRICULTURAL DEVELOPMENT FUND

UK Ag EXTENSION

Kentucky's Climate

Date of first freeze can vary



Kentucky Historical Lows

	Day	Year	Record Low(F)	Location	Data Source
January	19	1994	-37	Shelbyville	Climatological Data, Kentucky
February	2	1951	-32	Princeton	Climatological Data, Kentucky
December	24	1989	-24	Farmers	Climatological Data, Kentucky
March	6	1960	-14	Bonnieville	Climatological Data, Kentucky
November	30	1929	-9	Shelbyville	Climatological Data, Kentucky
April	2	1857	10	Millersburg	Climatological Data, Kentucky
October	27	1962	10	Dewey Dam	Climatological Data, Kentucky
May	10	1966	20	Falmouth	Climatological Data, Kentucky
September	26	1928	24	Farmers	Climatological Data, Kentucky
June	1	1966	29	Cumberland	Climatological Data, Kentucky
July	1	1988	34	Ashland	Climatological Data, Kentucky
August	31	1946	36	Clermont	Climatological Data, Kentucky

Kentucky is a transitional zone

Northern plants may respond more quickly to Kentucky's fluctuating temperatures, may require colder temperatures to induce dormancy.

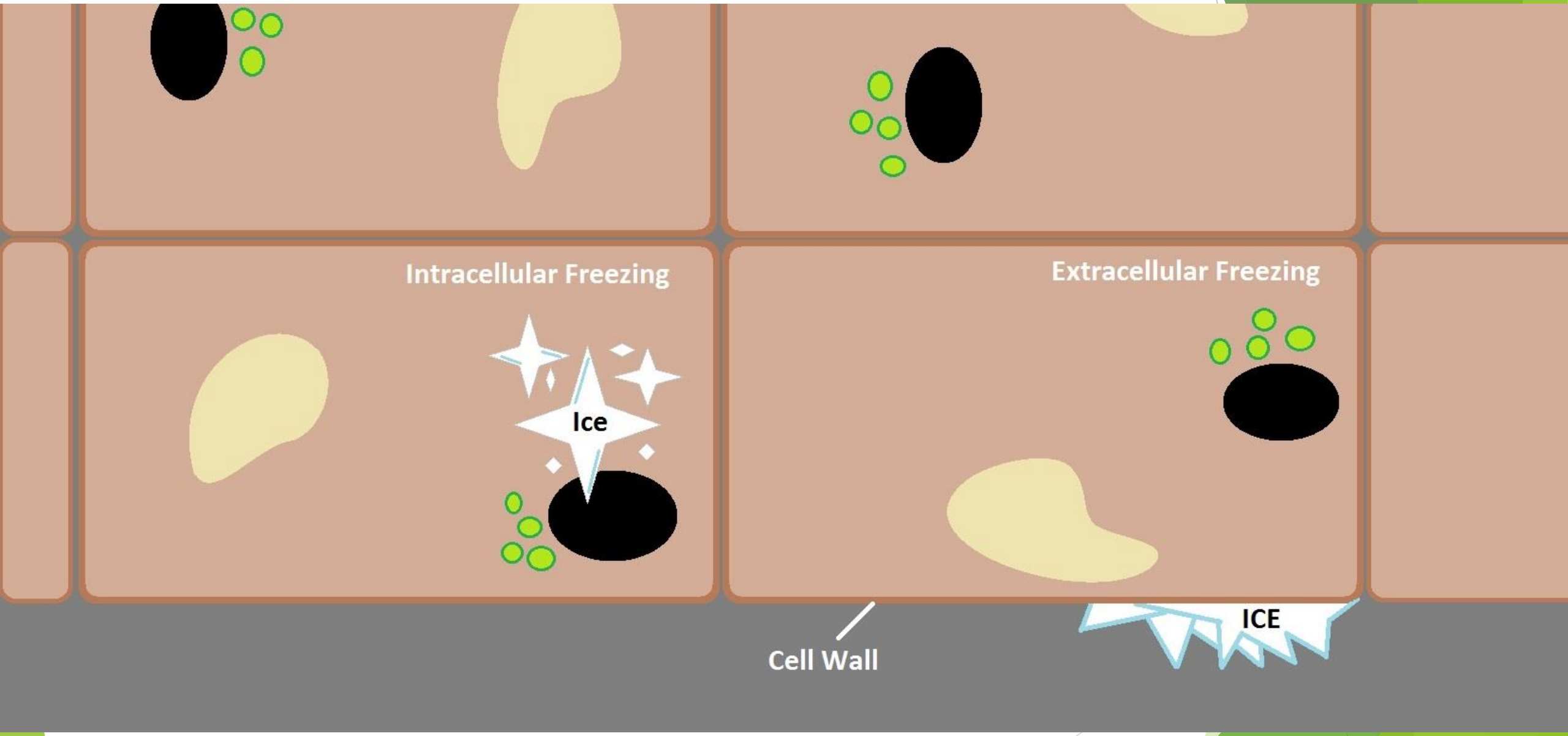
Physiological Effects of Freezing

Two basic biological strategies

- Plants go dormant to avoid injury
- Plants remain active and adapt physiologically

Phloem and Xylem

- Phloem may be disrupted by sap becoming more viscous as temperatures fall
- Xylem function may be interrupted by the formation of air pockets


Intracellular Freezing
Ice
Extracellular Freezing
ICE
Cell Wall

Types of freezing

- Freezing of extracellular water
  - Can help prevent intercellular freezing
  - Can lead to cellular dehydration

- Freezing of intercellular water
  - Mechanical damage to cells
  - Most plants cannot survive
  - Some plants develop tolerance

Extracellular Freezing

- Ice on external cell wall draws water from the interior.
- Dehydrated cells shrink
- Leads to cracking

Intracellular Freezing

- Ice crystals mechanically damage cells.
- Some plants can avoid this by altering the temperature at which water freezes (Resistance)
  - Increased solute, electrolytes, proteins, and salt levels to raise freeze temperature

Resistance

Resistance to freezing on plants is based either on tolerance to extracellular ice formation or the avoidance of intracellular freezing.

Acclimation (Hardening)

- Definition of acclimation: the process or result of acclimating; especially : physiological adjustment by an organism to environmental change (Merriam-Webster Dictionary)
- Triggered by:
  - Gradual reduction of temps to adapt plants to freezing temps
  - Decrease in daylength
  - Decreased light intensity

Plant cells harden by:

- Changes to the cell wall structure
- Changes to the plasma membrane
- Storage of sugars and starch in living and nonliving tissues

Growing shoots are cold sensitive and are unable to increase their resistance even after hardening.

So… How do we manage plants and production systems to minimize winter injury

Fertilizing

- Healthy, vigorous plants are better adapted to withstand freezing temperatures.
- Avoid inducing a late flush of growth with improper fertilizer timing.

Pruning

Pruning too late in season can cause a flush of soft growth that will burn in freezing temperatures.

Sunscald (Southwest Injury)

- Occurs on warm, sunny winter days.
- Sun warms outer cells (typically on the southwest facing part of tree) relative to the inner cells.
- Hardened cells become more active, imbibe water and pull away from frozen tissue.
- Temperature of the cells drop below freezing after sunset, killing the dehardened tissue and forming freeze cracks.

Overwintering Strategies

Container Production

Overwintering Containers

- Plants in containers are taken from the environment in which they evolved to survive.
- Roots can’t adapt to survive extremes.
- Roots in containers rapidly reach temperature of surrounding air

Overwintering Strategies

- Most techniques involve taking advantage of heat from the earth
  - Contact of containers with earth
  - Minimizing heat loss between containers
- The appropriateness of overwintering strategies differs with climate
- Icing plants only works for a short time and at temperatures near freezing

Root protection is your main goal

Roots in container production lack the insulating properties of soil

Table 1. Root-killing temperatures of container-grown ornamentals*		
Botanical Name	degrees Fahrenheit	degrees Centigrade
Acer palmatum 'Atropurpureum'	15^0F	-9.4^{0}C
Buxus sempervirens	27^0F	-2.7^{0}C
Cornus florida	22^0F	-5.6^{0}C
Cotoneaster dammeri	23^0F	-5^{0}C
Cryptomeria japonica	17^0F	-8.3^{0}C
Cytisus x praecox	16^0F	-8.9^{0}C
Daphne cneorum	23^0F	-5^{0}C
Euonymus alata	19^0F	-7.2^{0}C
Hedera helix 'Baltica'	15^0F	-9.4^{0}C
Ilex crenata 'Convexa'	23^0F	-5^{0}C
Ilex glabra	16^0F	-8.9^{0}C
Ilex 'Nellie R. Stevens'	23^0F	-5^{0}C
Ilex merserve	23^0F	-5^{0}C
Juniperus conferta	12^0F	-11.1^{0}C
Kalmia latifolia	15^0F	-9.4^{0}C
Pyracantha coccinea 'Lalandei'	23^0F	-5^{0}C
Rhododendron catawbiense	0^0F	-17.8^{0}C
Rhododendron 'Hinodegiri'	10^0F	-12.2^{0}C
Rhododendron 'P.J.M.' hybrids	-9^{0}F	-23.3^{0}C
Taxus x media 'Hicksii'	17^0F	-8.3^{0}C

Quonset Houses

Quonset Houses

- Various sizes, heights, lengths
- Generally also used as shade structures during the production season


IT28
CAT

Loads

1) Dead load
   - Weight of greenhouse structure and glazing
2) Live load
   - Weight of snow and water on roof
3) Wind load
   - Downward force due to wind pressure


1140

N.C. State
Horticulture

N.C. State
Horticulture

Pot-in-Pot

Small Houses vs Laying Down

Small Houses vs Laying Down

Outdoor/Mulching


13
PREMIER
PEAT MOSS TOURBE


PINE BARK
MULCH
DECORATIVE
GROUND COVER

Field Trees (Dug)

N.C. State Horticulture


UK

Questions

UKRECHort on YouTube