



Who is NICH?

The National Initiative for Consumer Horticulture is an all-volunteer collaboration of academic, industry, public gardens and non-profit horticulture sectors. Since 2015, they have been focused on providing science-based information and resources to support the art, science and business of consumer horticulture. Find more about NICH at: <https://consumerhort.org/>

What is in This Resource Packet?

NICH focuses on engaging with industry and academics to find key needs or gaps in horticultural resources or information and then works together with an academic multi-state group, Southern Extension Research Activity (SERA_50), to formulate resources to share with Extension members, GardenComm members and other educators or those who conduct outreach in consumer horticulture. Different topics may contain slightly different resources. This packet is focused on the science and application of the updated Winter Cold Hardiness Map. It contains:

File 1- Information about the development and utilization of the new 2023 map derived from a conversation NICH had with the scientific team that created the map.

File 2- A Frequently Asked Questions handout suitable for sharing directly or pulling information.

File 3- A lay summary of horticultural research that connects to these topics available in open-source journals to connect content developers and users with the foundational research that underlies these efforts.

File 4- Links to videos or other digital resources developed by University educators or other science-based sources related to these topics.

How Garden Comm International Members Can Use This Packet

These resources were developed to support your education, outreach and marketing to gardeners and members of the general public. There is no charge for their use, but we do request that NICH and individual authors where appropriate be cited. A great way to cite these resources is to link back to the NICH resource page:

This information was compiled by members of the National Initiative for Consumer Horticulture and SERA-50. Links and resources are posted at: <https://consumerhort.org/editorial-resources-for-consumer-horticulture/>

What should the gardening public know about the 2023 USDA Plant Hardiness Zone Map?

A candid discussion with two authors of the map, Dr. Chris Daly, Professor, Oregon State and Director, PRISM (Parameter-elevation Regressions on Independent Slopes Model) Climate Group, and Dr. Todd Rounsaville, Floral and Nursery Plants Research Horticulturist at the United States Department of Agriculture, Agricultural Research Service (USDA_ARS), along with Dr. Sarah White, Professor and Nursery Crops Extension Specialist at Clemson University, and C.L. Fornari, President of Garden Communicators International.

Purpose of the map(s):

The United States Department of Agriculture Plant Hardiness Zone Map is the standard by which gardeners and growers can determine which perennial plants are most likely to thrive at a location. The map is based on the average annual extreme minimum winter temperature, displayed as 10-degree F zones and 5-degree F half zones.

Previous editions available on the USDA web site include 1990 and 2012. It might be good to include these graphics or at least links to the maps. We should strive to indicate the origin of the maps by including the USDA and Oregon State University on these maps in publications. ***Under the terms of a Specific Cooperative Agreement between the U.S. Department of Agriculture and Oregon State University, OSU retains ownership of the Geographic Information System (GIS) datasets underlying the official 2012 and 2023 USDA Plant Hardiness Zone Maps. These datasets may be freely reproduced and redistributed, subject to the following conditions: (1) Both the [USDA-ARS logo](#) and [OSU logo](#) must be prominently displayed on any maps derived from the datasets. (2) The data may not be altered in any way unless (a) there is an explicit and prominently displayed disclaimer that the map is not the official USDA Plant Hardiness Zone Map, and (b) the USDA-ARS and OSU logos are eliminated.***



This information was compiled by members of the National Initiative for Consumer Horticulture. Links and resources are posted at:

Information in this document is meant to be shared with the gardening public. Information below in ***bold italics*** was taken directly from USDA's Plant Hardiness Zone Map website. When referencing content, please credit the sources for this document, including:

- USDA Plant Hardiness Zone Map, 2023. Agricultural Research Service, U.S. Department of Agriculture. Accessed from <https://planthardiness.ars.usda.gov/>
- Daly, C., Rounsaville, T., White, S., & Fornari, C.L. (2024, January 10). What should the gardening public know about the 2023 USDA Plant Hardiness Zone Map? [Panel presentation] Advisory Panel for the National Initiative for Consumer Horticulture Board of Directors, United States.
- What's the difference between weather and climate? (2024, February 27). National Oceanic and Atmospheric Administration National Centers for Environmental Information. <https://www.ncei.noaa.gov/news/weather-vs-climate#:~:text=Whereas%20weather%20refers%20to%20short,regions%20can%20have%20different%20climates>

It is good to note that the map only addresses one aspect of plant adaptation – winter hardiness. As noted later, there are many other climatic factors that affect plant growth and survival that the map does not address. Also, plant genetics as well as plant provenance (the geographic area where the plant or its ancestors originated) may play a factor in plant survival. While a given species of plant may be identified as cold hardy to a wide range of zones, individual selections from that species may not exhibit this range of hardiness.

History:

The 1990 map was drawn from weather data from 1974-1986 – 12 years of data. The 2012 map was compiled from 30 years of data and was developed using GIS datasets.

2023 map was based on 30 years of data.....***selected by the group of horticultural, botanical, and climatological experts who led the review of the latest revision as the best balance between smoothing out the fluctuations of year-to-year weather variation and the concept that, during their lifetimes, perennial plants mostly experience what is termed "weather" rather than "climate. The 1991-2020 period also aligns with the period currently in use by climatologists to describe baseline climate "normals" in the U.S.***

Map Construction Details:

The digital data used to construct the 2012 and especially the 2023 maps, based on GIS technology, allow for smaller areas of zone delineation than earlier maps. "For example, cities tend to hold more heat because they encompass large areas of concrete and blacktop, so a city or town might be assigned to a zone warmer than the surrounding countryside. Higher elevations tend to be colder than surrounding lower areas, so the top of a mountain might be an area of cooler zones. A location near a large body of unfrozen water, especially downwind from prevailing breeze from that water, might provide milder winter weather and be in a warmer zone. Because of this level of detail, the new map as issued by USDA and accessed from their web site, is best accessed using a broadband internet connection.

A complex algorithm was used for this edition of the PHZM to enable more accurate interpolation between weather reporting stations. This method accounts for factors such as elevation changes and proximity to bodies of water, which enabled mapping of more accurate zones.

All data were carefully examined to ensure that only the most reliable were used in the mapping. In the end, data from a total of 13,625 stations—a substantial increase compared to the 2012 map version--were incorporated into the maps. The USDA PHZM was produced with the latest version of PRISM, a highly sophisticated climate mapping technology developed at Oregon State University. The map was produced from a digital computer grid, with each cell measuring about a half mile on a side. PRISM estimated the mean annual extreme minimum temperature for each grid cell (or pixel on the map) by examining data from nearby stations; determining how the temperature changed with elevation; and

accounting for possible coastal effects, temperature inversions, and the type of topography (ridge top, hill slope, or valley bottom).

Climate Change and the New Map

Climate changes are usually based on trends in overall annual average temperatures recorded over 50-100 years. Because the USDA PHZM represents 30-year averages of what are essentially extreme weather events (the coldest temperature of the year), changes in zones are not reliable evidence of whether there has been global warming.

Compared to the 2012 and 1990 maps, zone boundaries in this 2023 edition have shifted in many areas. The new PHZM is generally about one quarter-zone warmer than reported in the 2012 PHZM throughout much of the United States, as a result of a more recent averaging period (1976-2005 vs. 1991-2020). However, some of the changes in the zones are the results of additional data sources and improved interpolation methods. These zone shifts can sometimes result in a cooler, rather than warmer, zone. The most substantial changes produced by additional data sources and improved interpolation methods are seen in upland areas of Alaska.

Overall, there was an increase in average winter extreme cold temperature of around 2.5 degrees Fahrenheit and this was especially true of locations east of the Rocky Mountains. It was also noted by Dr. Daly during the NICH advisory meeting that the current data period (1991-2020) left out some significant cold weather episodes in the 1970s and 1980s.

Using the Map (<https://planthardiness.ars.usda.gov/pages/how-to-use-the-maps>)

If your hardiness zone has changed in this edition of the USDA Plant Hardiness Zone Map (PHZM), it does not mean you should start removing plants from your garden or change what you are growing. What has thrived in your yard will most likely continue to thrive.

Hardiness zones in this map are based on the average annual extreme minimum temperature during a 30-year period in the past, not the lowest temperature that has ever occurred in the past or might occur in the future. Gardeners should keep that in mind when selecting plants, especially if they choose to "push" their hardiness zone by growing plants not rated for their zone. In addition, although this edition of the USDA PHZM is drawn in the most detailed scale (1/2-mile square) to date, there could still be microclimates that are too small to show up on the map.

This is a very good point. The map represents average annual extreme minimum temperatures over a 30-year period (1992-2020). Even one cold weather event that is colder than the average can affect plant winter hardiness. While changes in the map may encourage gardeners and other plantspeople to expand their plant pallet to species that are less cold hardy, this should be done very conservatively. Investigating whether a few new plants might make it in your landscape is exciting. Replacing many of the plants in your landscape to others that push the

boundaries of cold hardiness in your area may be quite risky. As C.L. Fornari, President of GardenComm, has said, the information provided by the new map should be considered as, “parameters, not promises; guidelines, not guarantees; and averages, not absolutes.”

Microclimates, which are fine-scale climate variations, can be small heat islands—such as those caused by blacktop and concrete—or cool spots (frost pockets) caused by small hills and valleys. Individual gardens also may have very localized microclimates. Your entire yard could be somewhat warmer or cooler than the surrounding area because it is sheltered or exposed. You also could have pockets within your garden that are warmer or cooler than the general zone for your area or for the rest of your yard, such as a sheltered area in front of a south-facing wall or a low spot where cold air pools first. No hardiness zone map can take the place of the detailed knowledge that gardeners learn about their own gardens through hands-on experience.

The newest map developed using the PRISM allows for geographical effects to climate such as altitude and proximity to large bodies of water. This geographical data is more precise than ever before, based on grids of 0.5 miles. Even so there are microclimates within each grid that may be warmer or colder due to other factors. Gardeners will learn what parts of their landscape may be warmer or colder than the average for their zone.

Many species of perennial plants gradually acquire cold hardiness in the fall when they experience shorter days and cooler temperatures. This hardiness is normally lost gradually in late winter as temperatures warm and days become longer. A bout of extremely cold weather early in the fall might injure plants even though the temperatures may not reach the average lowest temperature for your zone. Similarly, exceptionally warm weather in midwinter followed by a sharp change to seasonably cold weather may cause injury to plants as well. Such factors could not be taken into account in the USDA PHZM.

This is important to realize. Plant cold hardiness is a continuum over the winter season and may fluctuate based on climatic factors such as daylength and moisture as well as temperatures preceding an extreme cold event. Various plant species also develop and maintain cold hardiness in different ways so some species are more resilient to winter weather while others are more susceptible.

All PHZMs should serve as general guides. They are based on the average lowest temperatures, not the lowest ever. Growing plants at the extreme range of the coldest zone where they are adapted means that they could experience a year with a rare, extreme cold snap that lasts just a day or two, and plants that have thrived happily for several years could be lost. Gardeners need to keep that in mind and understand that past weather records cannot provide a guaranteed forecast for future variation in weather.

Other Factors Affecting Plant Survival

Many other environmental factors, in addition to hardiness zones, contribute to the success or failure of plants. Wind, soil type, soil moisture, humidity, pollution, snow, and winter sunshine can greatly affect the survival of plants. The way plants are placed in the landscape, how they are planted, and their size and health might also influence their survival.

- ***Light: To thrive, plants need to be planted where they will receive the proper amount of light. For example, plants that require partial shade that are at the limits of hardiness in your area might be injured by too much sun during the winter because it might cause rapid changes in the plant's internal temperature.***

Daylength is also known to play a factor in plant hardiness.

- ***Soil moisture: Plants have different requirements for soil moisture, and this might vary seasonally. Plants that might otherwise be hardy in your zone might be injured if soil moisture is too dry in late autumn and they enter dormancy while suffering moisture stress.***
- ***Temperature: Plants grow best within a range of optimal temperatures, both cold and hot. That range may be wide for some varieties and species but narrow for others.***

The effect on heat on plants is not addressed in the Plant hardiness zone map.

- ***Duration of exposure to cold: Many plants that can survive a short period of exposure to cold may not tolerate longer periods of cold weather.***
- ***Humidity: High relative humidity limits cold damage by reducing moisture loss from leaves, branches, and buds. Cold injury can be more severe if the humidity is low, especially for evergreens.***

Many extreme weather events are a combination of extremely cold temperature coupled with windy conditions and low relative humidity under sunny conditions. Many "Arctic Vortex" events fit this scenario. A group of plants particularly vulnerable to these conditions are the broadleaved evergreens. The leaves of these plants photosynthesize during winter, which requires movement of water from the roots to the leaves. Plants cannot obtain water from frozen soil and so these weather conditions often result in drying and sometimes extreme desiccation of leaves and green stems. This results in severe winter damage due to a combination of weather factors when these plants may be considered cold hardy based on plant hardiness zone alone.

About These Resources

This publication was written to assist garden communicators in sharing the research-based findings about horticulture topics with the gardening public. It was collaboratively developed by the Consumer Horticulture Southern Extension and Research Activity (SERA_Temp50), a working group organized through the Southern Association of Agricultural Experiment Station Directors. SERA_Temp50 includes members from Auburn Univ., Clemson Univ., Univ. of Kentucky, Univ. of Georgia, Univ. of Hawaii, Louisiana State Univ., The Ohio State Univ., Univ. of Minnesota, Mississippi State Univ., Univ. of Nebraska, North Carolina State Univ., Univ. of Tennessee, and Virginia Tech. SERA_Temp50 also operates as the National Initiative for Consumer Horticulture (NICH) Academic/Government Council and serves to connect the academic horticulture community to NICH.

The National Initiative for Consumer Horticulture (NICH) is a consortium of industry leaders who are promoting the benefits and value of horticulture. NICH brings together academia, government, industry and nonprofits to cultivate the growth and development of a healthy world through landscapes, gardens, and plants – indoors and out.

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