

Hardiness zone

A **hardiness zone** is a geographic area defined as having a certain average annual minimum temperature, a factor relevant to the survival of many plants. In some systems other statistics are included in the calculations. The original and most widely used system, developed by the [United States Department of Agriculture](#) (USDA) as a rough guide for landscaping and gardening, defines 13 zones by long-term average annual extreme minimum temperatures. It has been adapted by and to other countries (such as Canada) in various forms.

Unless otherwise specified, in American contexts "hardiness zone" or simply "zone" usually refers to the USDA scale. For example, a plant may be described as "hardy to zone 10": this means that the plant can withstand a minimum temperature of 30 °F (−1.1 °C) to 40 °F (4.4 °C).

Other hardiness rating schemes have been developed as well, such as the UK [Royal Horticultural Society](#) and US [Sunset Western Garden Book](#) systems. A **heat zone** (see below) is instead defined by annual high temperatures; the [American Horticultural Society](#) (AHS) heat zones use the average number of days per year when the temperature exceeds 30 °C (86 °F).

United States hardiness zones (USDA scale)

The USDA system was originally developed to aid gardeners and landscapers in the United States.

State-by-state maps, along with an electronic system that allows finding the zone for a particular zip code, can be found at the [USDA Agricultural Research Service](#) (USDA-ARS) website.

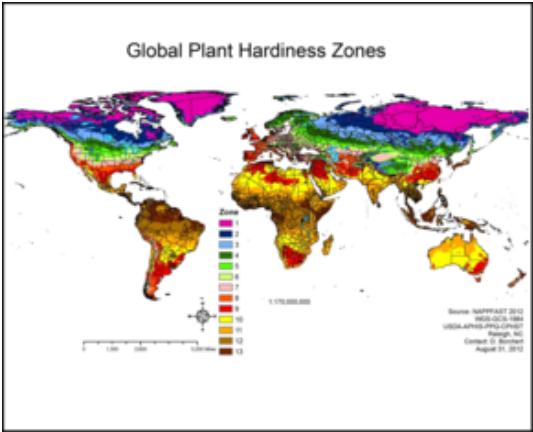
In the United States, most of the warmer zones (zones 9, 10, and 11) are located in the deep southern half of the country and on the southern coastal margins. Higher zones can be found in [Hawaii](#) (up to 12) and [Puerto Rico](#) (up to 13). The southern middle portion of the mainland and central coastal areas are in the middle zones (zones 8, 7, and 6). The far northern portion on the central interior of the mainland have some of the coldest zones (zones 5, 4, and small area of zone 3) and often have much less consistent range of temperatures in winter due to being more continental, especially further west with higher diurnal temperature variations, and thus the zone map has its limitations in these areas. Lower zones can be found in [Alaska](#) (down to 1). The low latitude and often stable weather in [Florida](#), the [Gulf Coast](#), and southern [Arizona](#) and [California](#), are responsible for the rarity of episodes of severe cold relative to normal in those areas. The warmest zone in the 48 contiguous states is the [Florida Keys](#) (11b) and the coldest is in north-central [Minnesota](#) (2b). A couple of locations on the northern coast of Puerto Rico

| Average Annual Extreme Minimum Temperature 1976-2005 | | | |
|--|------|----------------|--|
| Temp (F) | Zone | Temp (C) | |
| -60 to -50 | 1 | -51.1 to -45.6 | |
| -50 to -40 | 2 | -45.6 to -40 | |
| -40 to -30 | 3 | -40 to -34.4 | |
| -30 to -20 | 4 | -34.4 to -28.9 | |
| -20 to -10 | 5 | -28.9 to -23.3 | |
| -10 to 0 | 6 | -23.3 to -17.8 | |
| 0 to 10 | 7 | -17.8 to -12.2 | |
| 10 to 20 | 8 | -12.2 to -6.7 | |
| 20 to 30 | 9 | -6.7 to -1.1 | |
| 30 to 40 | 10 | -1.1 to 4.4 | |
| 40 to 50 | 11 | 4.4 to 10 | |
| 50 to 60 | 12 | 10 to 15.6 | |
| 60 to 70 | 13 | 15.6 to 21.1 | |

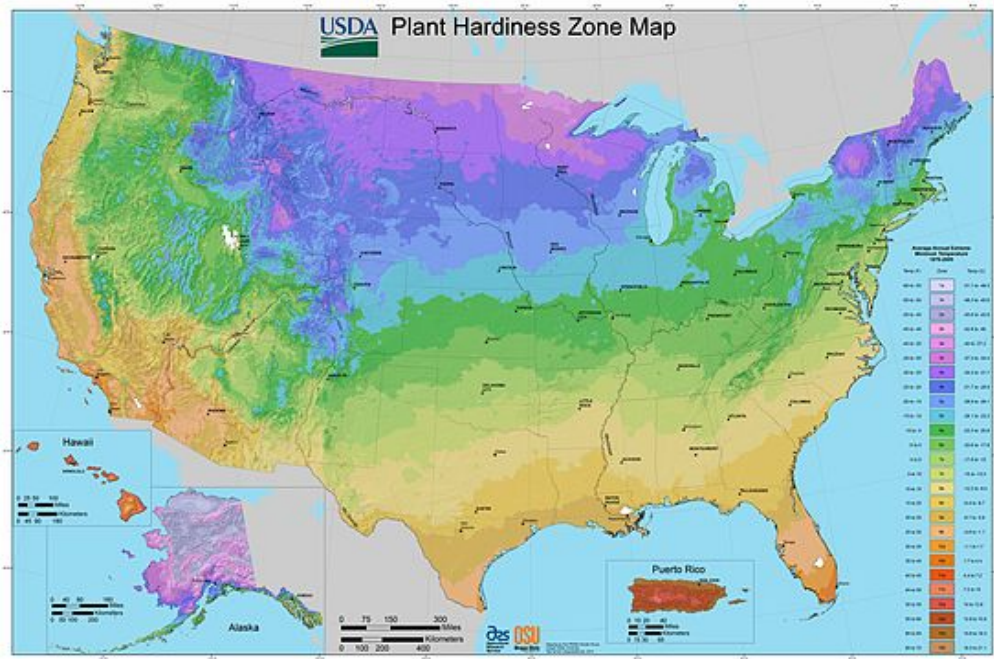
Temperature scale used to define USDA hardiness zones. These are annual extreme minima (an area is assigned to a zone by taking the lowest temperature recorded there in a given year). As shown, the USDA uses a GIS dataset averaged over 1976 to 2005 for its United States maps.

have the warmest hardiness zone in the United States at 13b. Conversely, isolated inland areas of Alaska have the coldest hardiness zone in the United States at 1a.

Definitions



Global Plant Hardiness Zones (approximate)



2012 update of the Hardiness Zone Map

| Zone | | From | To |
|------|---|---------------------|-------------------|
| 0 | a | < -65 °F (-53.9 °C) | |
| | b | -65 °F (-53.9 °C) | -60 °F (-51.1 °C) |
| 1 | a | -60 °F (-51.1 °C) | -55 °F (-48.3 °C) |
| | b | -55 °F (-48.3 °C) | -50 °F (-45.6 °C) |
| 2 | a | -50 °F (-45.6 °C) | -45 °F (-42.8 °C) |
| | b | -45 °F (-42.8 °C) | -40 °F (-40 °C) |
| 3 | a | -40 °F (-40 °C) | -35 °F (-37.2 °C) |
| | b | -35 °F (-37.2 °C) | -30 °F (-34.4 °C) |
| 4 | a | -30 °F (-34.4 °C) | -25 °F (-31.7 °C) |
| | b | -25 °F (-31.7 °C) | -20 °F (-28.9 °C) |
| 5 | a | -20 °F (-28.9 °C) | -15 °F (-26.1 °C) |
| | b | -15 °F (-26.1 °C) | -10 °F (-23.3 °C) |
| 6 | a | -10 °F (-23.3 °C) | -5 °F (-20.6 °C) |

| | | | |
|----|---|-------------------|------------------|
| | b | −5 °F (−20.6 °C) | 0 °F (−17.8 °C) |
| 7 | a | 0 °F (−17.8 °C) | 5 °F (−15 °C) |
| | b | 5 °F (−15 °C) | 10 °F (−12.2 °C) |
| 8 | a | 10 °F (−12.2 °C) | 15 °F (−9.4 °C) |
| | b | 15 °F (−9.4 °C) | 20 °F (−6.7 °C) |
| 9 | a | 20 °F (−6.7 °C) | 25 °F (−3.9 °C) |
| | b | 25 °F (−3.9 °C) | 30 °F (−1.1 °C) |
| 10 | a | 30 °F (−1.1 °C) | +35 °F (1.7 °C) |
| | b | +35 °F (1.7 °C) | +40 °F (4.4 °C) |
| 11 | a | +40 °F (4.4 °C) | +45 °F (7.2 °C) |
| | b | +45 °F (7.2 °C) | +50 °F (10 °C) |
| 12 | a | +50 °F (10 °C) | +55 °F (12.8 °C) |
| | b | +55 °F (12.8 °C) | 60 °F (15.6 °C) |
| 13 | a | 60 °F (15.6 °C) | 65 °F (18.3 °C) |
| | b | > 65 °F (18.3 °C) | |

History

The first attempts to create a geographical hardiness zone system were undertaken by two researchers at the Arnold Arboretum in Boston; the first was published in 1927 by Alfred Rehder,^[1] and the second by Donald Wyman in 1938.^[2] The Arnold map was subsequently updated in 1951, 1967, and finally 1971, but eventually fell out of use completely.

The modern USDA system began at the US National Arboretum in Washington. The first map was issued in 1960, and revised in 1965. It used uniform 10-degree Fahrenheit ranges, and gradually became widespread among American gardeners.^{[3][4]}

The USDA map was revised and reissued in 1990 with freshly available climate data, this time with five-degree distinctions dividing each zone into new "a" and "b" subdivisions.

In 2003, the American Horticultural Society (AHS) produced a draft revised map, using temperature data collected from July 1986 to March 2002. The 2003 map placed many areas approximately a half-zone higher (warmer) than the USDA's 1990 map. Reviewers noted the map zones appeared to be closer to the original USDA 1960 map in its overall zone delineations. Their map purported to show finer detail, for example, reflecting urban heat islands by showing the downtown areas of several cities (e.g., Baltimore, Maryland; Washington, D.C., and Atlantic City, New Jersey) as a full zone warmer than outlying areas. The map excluded the detailed a/b half-zones introduced in the USDA's 1990 map, an omission widely criticized by horticulturists and gardeners due to the coarseness of the resulting map. The USDA rejected the AHS 2003 draft map and created its own map in an interactive computer format, which the American Horticultural Society now uses.^[5]

In 2006, the Arbor Day Foundation released an update of U.S. hardiness zones, using mostly the same data as the AHS. It revised hardiness zones, reflecting generally warmer recent temperatures in many parts of the country, and appeared similar to the AHS 2003 draft. The Foundation also did away with the more detailed a/b half-zone delineations.^[6]

In 2012 the USDA updated their plant hardiness map based on 1976–2005 weather data, using a longer period of data to smooth out year-to-year weather fluctuations.^[7] Two new zones (12 and 13) were added to better define and improve information sharing on tropical and semitropical plants, they also appear on the maps of Hawaii and Puerto Rico. There is a very small spot east of San Juan, Puerto Rico, that includes the airport in coastal Carolina, where the mean minimum is 67 degrees F (19 C), which is classified as hardiness Zone 13b, the highest category, with

temperatures rarely below 65 °F (18 °C). The map has a higher resolution than previous editions, and is able to show local variations due to factors such as elevation or large bodies of water. Many zone boundaries were changed as a result of the more recent data, as well as new mapping methods and additional information gathered. Many areas were a half-zone warmer than the previous 1990 map.^[8] The 2012 map was created digitally for the internet, and includes a ZIP Code zone finder and an interactive map.^{[9][10]}

In 2015, the Arbor Day Foundation revised another map, also with no a and b subdivisions, showing many areas having zones even warmer, with the most notable changes in the Mid Atlantic and Northeast, showing cities like Philadelphia, New York City and Washington D.C. in zone 8, due to their urban heat islands.^[11]

Selected U.S. cities

The USDA plant hardiness zones for selected U.S. cities as based on the 2012 map are the following:

| City | Zone |
|--------------------------------------|--------------|
| <u>Albany, New York</u> | 5b/6a |
| <u>Albuquerque, New Mexico</u> | 7b |
| <u>Allentown, Pennsylvania</u> | 6b/7a |
| <u>Anchorage, Alaska</u> | 4b/5a |
| <u>Atlanta, Georgia</u> | 8a |
| <u>Atlantic City, New Jersey</u> | 7b |
| <u>Attu Island, Alaska</u> | 8a |
| <u>Austin, Texas</u> | 8b/9a |
| <u>Baltimore, Maryland</u> | 7b |
| <u>Bakersfield, California</u> | 9b |
| <u>Boise, Idaho</u> | 7a |
| <u>Boston, Massachusetts</u> | 6b |
| <u>Buffalo, New York</u> | 6a |
| <u>Burlington, Vermont</u> | 5a |
| <u>Cape Hatteras, North Carolina</u> | 8b/9a |
| <u>Charleston, South Carolina</u> | 8b/9a |
| <u>Charleston, West Virginia</u> | 7a |
| <u>Charlotte, North Carolina</u> | 7b/8a |
| <u>Chattanooga, Tennessee</u> | 7a/7b |
| <u>Chicago, Illinois</u> | 6a |
| <u>Cincinnati, Ohio</u> | 6b |
| <u>Cleveland, Ohio</u> | 6b |
| <u>Colorado Springs, Colorado</u> | 5b/6a |
| <u>Columbus, Ohio</u> | 6a/6b |
| <u>Dallas, Texas</u> | 8a/8b |
| <u>Denver, Colorado</u> | 5b/6a |
| <u>Detroit, Michigan</u> | 6b |
| <u>El Paso, Texas</u> | 8a/8b |
| <u>Fairbanks, Alaska</u> | 2a |
| <u>Fresno, California</u> | 9b |
| <u>Greensboro, North Carolina</u> | 7b |
| <u>Harrisburg, Pennsylvania</u> | 7a |
| <u>Hartford, Connecticut</u> | 6b |
| <u>Honolulu, Hawaii</u> | 12b |
| <u>Houston, Texas</u> | 9a |
| <u>Indianapolis, Indiana</u> | 5b/6a |
| <u>Jacksonville, Florida</u> | 9a |
| <u>Juneau, Alaska</u> | 6b/7a |
| <u>Kansas City, Missouri</u> | 6a/6b |
| <u>Las Vegas, Nevada</u> | 9a |

| | |
|-----------------------------------|-------------------|
| <u>Little Rock, Arkansas</u> | 8a |
| <u>Los Angeles, California</u> | 9b/10a/10b |
| <u>Louisville, Kentucky</u> | 6b/7a |
| <u>Memphis, Tennessee</u> | 7b |
| <u>Miami, Florida</u> | 10b/11a |
| <u>Milwaukee, Wisconsin</u> | 6a |
| <u>Minneapolis, Minnesota</u> | 4b/5a |
| <u>Montauk, New York</u> | 7b |
| <u>Nantucket, Massachusetts</u> | 7a |
| <u>Nashville, Tennessee</u> | 7a |
| <u>New Orleans, Louisiana</u> | 9b |
| <u>New York, New York</u> | 7b |
| <u>Norfolk, Virginia</u> | 8a |
| <u>Oklahoma City, Oklahoma</u> | 7a |
| <u>Omaha, Nebraska</u> | 5b |
| <u>Orlando, Florida</u> | 9b |
| <u>Philadelphia, Pennsylvania</u> | 7a/7b |
| <u>Phoenix, Arizona</u> | 9b/10a |
| <u>Pierre, South Dakota</u> | 4b/5a |
| <u>Pittsburgh, Pennsylvania</u> | 6b |
| <u>Pocatello, Idaho</u> | 5b |
| <u>Portland, Maine</u> | 5b |
| <u>Portland, Oregon</u> | 8b/9a |
| <u>Providence, Rhode Island</u> | 6b |
| <u>Quad Cities, Iowa/Illinois</u> | 5b |
| <u>Raleigh, North Carolina</u> | 7b/8a |
| <u>Riverside, California</u> | 9b |
| <u>Reno, Nevada</u> | 7a |
| <u>Roanoke, Virginia</u> | 7a/7b |
| <u>Sacramento, California</u> | 9b |
| <u>St. George, Utah</u> | 8b |
| <u>St. Louis, Missouri</u> | 6b/7a |
| <u>Salt Lake City, Utah</u> | 7a/7b |
| <u>San Antonio, Texas</u> | 8b/9a |
| <u>San Diego, California</u> | 10b/11a |
| <u>San Francisco, California</u> | 10a/10b |
| <u>San Jose, California</u> | 9b/10a |
| <u>San Juan, Puerto Rico</u> | 12b/13a |
| <u>Savannah, Georgia</u> | 8b |
| <u>Scranton, Pennsylvania</u> | 6a/6b |
| <u>Seattle, Washington</u> | 8b/9a |

| | |
|----------------------------|---------------|
| <u>Tampa, Florida</u> | 9b/10a |
| <u>Tucson, Arizona</u> | 9b |
| <u>Tulsa, Oklahoma</u> | 7a |
| <u>Tuscaloosa, Alabama</u> | 8a |
| <u>Utqiagvik, Alaska</u> | 2b |
| <u>Washington, D.C.</u> | 7a/7b |
| <u>Wichita, Kansas</u> | 6b |

Limitations

As the USDA system is based entirely on average annual extreme minimum temperature in an area, it is limited in its ability to describe the climatic conditions a gardener may have to account for in a particular area: there are many other factors that determine whether or not a given plant can survive in a given zone.

Zone information alone is often not adequate for predicting winter survival, since factors such as frost dates and frequency of snow cover can vary widely between regions. Even the extreme minimum itself may not be useful when comparing regions in widely different climate zones. As an extreme example, due to the Gulf stream most of the United Kingdom is in zones 8–9, while in the US, zones 8–9 include regions such as the subtropical coastal areas of the southeastern US and Mojave and Chihuahuan inland deserts, thus an American gardener in such an area may only have to plan for several nights of cold temperatures per year, while their British counterpart may have to plan for several months.

In addition, the zones do not incorporate any information about duration of cold temperatures, summer temperatures, or sun intensity insolation; thus sites which may have the same mean winter minima on the few coldest nights and be in the same garden zone, but have markedly different climates. For example, zone 8 covers coastal, high latitude, cool summer locations like Seattle and London, as well as lower latitude, subtropical hot summer climates like Charleston and Madrid. Farmers, gardeners, and landscapers in the former two must plan for entirely different growing conditions from those in the latter, in terms of length of hot weather and sun intensity. Coastal Ireland and central Florida are both Zone 10, but have radically different climates 99% of the year .

The hardiness scales do not take into account the reliability of snow cover in the colder zones. Snow acts as an insulator against extreme cold, protecting the root system of hibernating plants. If the snow cover is reliable, the actual temperature to which the roots are exposed will not be as low as the hardiness zone number would indicate. As an example, Quebec City in Canada is located in zone 4, but can rely on a significant snow cover every year, making it possible to cultivate plants normally rated for zones 5 or 6. But, in Montreal, located to the southwest in zone 5, it is sometimes difficult to cultivate plants adapted to the zone because of the unreliable snow cover.

Many plants may survive in a locality but will not flower if the day length is insufficient or if they require vernalization (a particular duration of low temperature).

There are many other climate parameters that a farmer, gardener, or landscaper may need to take into account as well, such as humidity, precipitation, storms, rainy-dry cycles or monsoons, and site considerations such as soil type, soil drainage and water retention, water table, tilt towards or away from the sun, natural or manmade protection from excessive sun, snow, frost, and wind, etc. The annual extreme minimum temperature is a useful indicator, but ultimately only one factor among many for plant growth and survival.^{[9][3][12]}

Alternatives

An alternative means of describing plant hardiness is to use "indicator plants". In this method, common plants with known limits to their range are used.

Sunset publishes a series that breaks up climate zones more finely than the USDA zones, identifying 45 distinct zones in the US, incorporating ranges of temperatures in all seasons, precipitation, wind patterns, elevation, and length and structure of the growing season.^[13]

In addition, the Köppen climate classification system can be used as a more general guide to growing conditions when considering large areas of the Earth's surface or attempting to make comparisons between different continents.^[14] The Trewartha climate classification is often a good "real world" concept of climates and their relation to plants and their average growing conditions.

Australian hardiness zones

The Australian National Botanic Gardens have devised another system keeping with Australian conditions. The zones are defined by steps of 5 degrees Celsius, from -15--10 °C for zone 1 to 15-20 °C for zone 7.^[15] They are numerically about 6 lower than the USDA system. For example, Australian zone 3 is roughly equivalent to USDA zone 9. The higher Australian zone numbers had no US equivalents prior to the 2012 addition by USDA of zones 12 and 13.

The spread of weather stations may be insufficient and too many places with different climates are lumped together. Only 738 Australian stations have records of more than ten years (one station per 98,491 hectares or 243,380 acres), though more populated areas have relatively fewer hectares per station. Mount Isa has three climatic stations with more than a ten-year record. One is in zone 4a, one in zone 4b, and the other is in zone 5a. Sydney residents are split between zones 3a and 4b. Different locations in the same city are suitable for different plants.

Canadian hardiness zones

Climate variables that reflect the capacity and detriments to plant growth are used to develop an index that is mapped to Canada's Plant Hardiness Zones.^[16] This index comes from a formula originally developed by Ouellet and Sherk in the mid-1960s.^{[17][18][19]}

The formula used is:
$$Y = -67.62 + 1.734X_1 + 0.1868X_2 + 69.77X_3 + 1.256X_4 + 0.006119X_5 + 22.37X_6 - 0.01832X_7$$

where:

- Y = estimated index of suitability
- X_1 = monthly mean of the daily minimum temperatures (°C) of the coldest month
- X_2 = mean frost free period above 0 °C in days
- X_3 = amount of rainfall (R) from June to November, inclusive, in terms of $R/(R+a)$ where $a=25.4$ if R is in millimeters and $a=1$ if R is in inches
- X_4 = monthly mean of the daily maximum temperatures (°C) of the warmest month
- X_5 = winter factor expressed in terms of $(0\text{ °C} - X_1)R_{\text{jan}}$ where R_{jan} represents the rainfall in January expressed in mm
- X_6 = mean maximum snow depth in terms of $S/(S+a)$ where $a=25.4$ if S is in millimeters and $a=1$ if S is in inches
- X_7 = maximum wind gust in (km/hr) in 30 years.

| City | Canadian Zone ^[16] | USDA Zone ^[16] |
|--------------------|-------------------------------|---------------------------|
| <u>Calgary</u> | 4a | 4a |
| <u>Edmonton</u> | 4a | 3b |
| <u>Halifax</u> | 6b | 6a |
| <u>Montreal</u> | 6a | 4b |
| <u>Ottawa</u> | 5b | 4b |
| <u>Saskatoon</u> | 3b | 3a |
| <u>St. John's</u> | 6a | 7a |
| <u>Toronto</u> | 7a | 5b |
| <u>Vancouver</u> | 8b | 8b |
| <u>Victoria</u> | 9a | 9a |
| <u>Winnipeg</u> | 4a | 3b |
| <u>Yellowknife</u> | 0a | 2a |

For practical purposes, Canada has adopted the American hardiness zone classification system. The 1990 version of the USDA Plant Hardiness Zone Map included Canada and Mexico, but they were removed with the 2012 update to focus on the United States and Puerto Rico.^[8] The Canadian government publishes both Canadian and USDA-style zone maps.^[16]

European hardiness zones

Selected European cities

The table below provides USDA hardiness zone data for selected European cities:

| City | Zone |
|---|---------------|
| <u>Amsterdam, Netherlands</u> ^[20] | 8b |
| <u>Barcelona, Spain</u> ^[21] | 10a |
| <u>Belgrade, Serbia</u> ^[22] | 7b/8a |
| <u>Bratislava, Slovakia</u> ^[23] | 7a/7b |
| <u>Bucharest, Romania</u> ^[24] | 7a/7b |
| <u>Catania, Italy</u> ^[25] | 9b/10a |
| <u>Dublin, Ireland</u> ^[26] | 8b/9a |
| <u>Edinburgh, Scotland, UK</u> ^[26] | 8a/8b |
| <u>Glasgow, Scotland, UK</u> ^[26] | 8b |
| <u>Helsinki, Finland</u> ^[27] | 6b |
| <u>Kaliningrad, Russia</u> ^[28] | 6b/7a |
| <u>Kraków, Poland</u> ^[29] | 7a |
| <u>Lisbon, Portugal</u> ^[30] | 10b |
| <u>London, England</u> ^[26] | 8b/9a |
| <u>Ljubljana, Slovenia</u> ^[31] | 7b |
| <u>Madrid, Spain</u> ^[21] | 9a |
| <u>Manchester, England</u> ^[26] | 8b |
| <u>Milan, Italy</u> ^[25] | 9a |
| <u>Moscow, Russia</u> ^[28] | 5a |
| <u>Paris, France</u> ^[32] | 8b/9a |
| <u>Portsmouth, England</u> ^[26] | 9a |
| <u>Prague, Czech Republic</u> ^[33] | 7b |
| <u>Riga, Latvia</u> ^[34] | 6b |
| <u>Rome, Italy</u> ^[25] | 9b |
| <u>Rovaniemi, Finland</u> ^[27] | 4a |
| <u>Sarajevo, Bosnia and Herzegovina</u> ^[35] | 7a/7b |
| <u>Simferopol, Ukraine</u> ^[36] | 6b |
| <u>Sochi, Russia</u> ^[28] | 9a |
| <u>Stockholm, Sweden</u> ^[37] | 7a/7b |
| <u>Tallinn, Estonia</u> ^[38] | 6a/6b |
| <u>Tuapse, Russia</u> ^[28] | 8b |
| <u>Trondheim, Norway</u> ^[39] | 7b |
| <u>Valencia, Spain</u> ^[21] | 10a |
| <u>Vienna, Austria</u> ^[40] | 7b/8a |
| <u>Vorkuta, Russia</u> ^[28] | 2a/2b |
| <u>Warsaw, Poland</u> ^[29] | 6b |

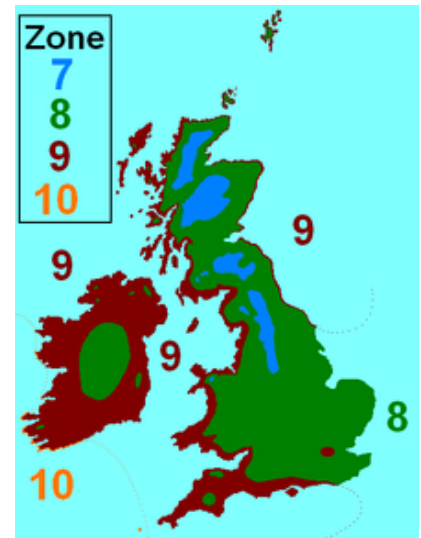
| | |
|--|--------------------|
| <u>Zürich, Switzerland</u> ^[41] | 7b/8a |
| <u>Antwerp, Belgium</u> ^[42] | 8a |
| <u>Belfast, Northern Ireland</u> ^[26] | 8a/8b/9a |
| <u>Berlin, Germany</u> ^[43] | 7a |
| <u>Birmingham, England</u> ^[26] | 8b |
| <u>Cardiff, Wales</u> ^[26] | 8b/9a |
| <u>Copenhagen, Denmark</u> ^[44] | 8a/8b |
| <u>Düsseldorf, Germany</u> ^[43] | 8a |
| <u>Funchal, Portugal</u> ^[30] | 11b |
| <u>Gdańsk, Poland</u> ^[29] | 7a |
| <u>Hamburg, Germany</u> ^[43] | 7b |
| <u>Istanbul, Turkey</u> ^[45] | 8a/8b/9a/9b |
| <u>La Coruña, Spain</u> ^[21] | 10b |
| <u>Las Palmas, Spain</u> ^[46] | 12b |
| <u>Marseille, France</u> ^[32] | 9a/9b |
| <u>Minsk, Belarus</u> ^[47] | 5a |
| <u>Munich, Germany</u> ^[43] | 6b |
| <u>Murmansk, Russia</u> ^[28] | 4a |
| <u>Newcastle, England, UK</u> ^[26] | 8a/8b |
| <u>Nicosia, Cyprus</u> ^[48] | 9b |
| <u>Oslo, Norway</u> ^[39] | 7a |
| <u>Palermo, Italy</u> ^[25] | 10b/11a |
| <u>Plymouth, England, UK</u> ^[26] | 9a/9b |
| <u>Porto, Portugal</u> ^[30] | 10a |
| <u>Poznań, Poland</u> ^[29] | 6b |
| <u>Reykjavík, Iceland</u> ^[49] | 7b/8a |
| <u>Saint Petersburg, Russia</u> ^[28] | 5a |
| <u>Simrishamn, Sweden</u> ^[37] | 8a |
| <u>Sofia, Bulgaria</u> ^[50] | 6b/7a |
| <u>Strasbourg, France</u> ^[32] | 8a |
| <u>Thessaloniki, Greece</u> ^[51] | 8b/9a |
| <u>Tromsø, Norway</u> ^[39] | 7a/7b |
| <u>Umeå, Sweden</u> ^[37] | 5a/5b |
| <u>Valletta, Malta</u> ^[52] | 10b |
| <u>Vilnius, Lithuania</u> ^[53] | 5b |
| <u>Wrocław, Poland</u> ^[29] | 6b |
| <u>Zagreb, Croatia</u> ^[54] | 7b/8a |

Britain and Ireland

USDA zones do not work particularly well in the UK as they are designed for continental climates and subtropical climates.^[55] The high latitude, weaker solar intensity, and cooler UK summers must be considered when comparing to US equivalent. New growth may be insufficient or fail to harden off affecting winter survival in the shorter and much cooler UK summers.^[55]

Owing to the moderating effect of the North Atlantic Current on the Irish and British temperate maritime climate, Britain, and Ireland even more so, have milder winters than their northerly position would otherwise afford. This means that the USDA hardiness zones relevant to Britain and Ireland are quite high, from 7 to 10, as shown below.^[56]

7. In Scotland the Grampians, Northwest Highlands and locally in the Southern Uplands; in England the Pennines; and in Wales the highest part of Snowdonia.
8. Most of England, Wales and Scotland, parts of central Ireland, and Snaefell on the Isle of Man.
9. Most of western and southern England and Wales, western Scotland, also a very narrow coastal fringe on the east coast of Scotland and northeast England (within 5 km (3.1 mi) of the North Sea), London, the West Midlands Urban Area, most of Ireland, and most of the Isle of Man.
10. Very low-lying coastal areas of the southwest of Ireland and the Isles of Scilly.



Britain and Ireland's hardiness zones, USDA scale, 2006

In 2012 the United Kingdom's Royal Horticultural Society introduced new hardiness ratings for plants, not places. These run from H7, the hardiest (tolerant of temperatures below -20°C (-4°F)) to H1a (needing temperatures above 15°C (59°F)).^[57] The RHS hardiness ratings are based on absolute minimum winter temperatures (in $^{\circ}\text{C}$) rather than the long-term average annual extreme minimum temperatures that define USDA zones.^[57]

Scandinavia and Baltic Sea Region

Scandinavia lies at the same latitude as Alaska or Greenland, but the effect of the warm North Atlantic Current is even more pronounced here than it is in Britain and Ireland. Save for a very small spot near Karasjok, Norway, which is in zone 2, nowhere in the Arctic part of Scandinavia gets below zone 3. The Faroe Islands, at $62\text{--}63^{\circ}\text{N}$ are in zone 8, as are the outer Lofoten Islands at 68°N . Tromsø, a coastal city in Norway at 70°N , is in zone 7, and even Longyearbyen, the northernmost true city in the world at 78°N , is still in zone 4. All these coastal locations have one thing in common, though, which are cool, damp summers, with temperatures rarely exceeding 20°C (68°F), or 15°C (59°F) in Longyearbyen. This shows the importance of taking heat zones into account for better understanding of what may or may not grow.

In Sweden and Finland generally, at sea level to 500 metres (1,600 ft), zone 3 is north of the Arctic Circle, including cities like Karesuando and Pajala. Kiruna is the major exception here, which being located on a hill above frost traps, is in zone 5. Zone 4 lies between the Arctic Circle and about $64\text{--}66^{\circ}\text{N}$, with cities such as Oulu, Rovaniemi and Jokkmokk, zone 5 (south to $61\text{--}62^{\circ}\text{N}$) contains cities such as Tampere, Umeå, and Östersund. Zone 6 covers the south of mainland Finland, Sweden north of 60°N , and the high plateau of Småland further south. Here one will find cities such as Gävle, Örebro, Sundsvall, and Helsinki. Åland, as well as coastal southern Sweden, and the Stockholm area are in zone 7. The west coast of Sweden (Gothenburg and southwards) enjoys particularly mild winters and lies in zone 7, therefore being friendly to some hardy exotic species (found, for example, in the Gothenburg Botanical Garden), the southeast coast of Sweden has a colder winter due to the absence of the Gulf Stream.

Denmark is in zones 9a, 8b, and 8a.^[58]

Estonia is divided to warmer West and North coast (Tallinn 6b, Haapsalu 7b, Kärdla 7a, Kuressaare 7a, Paide 6a, Rakvere 6a, Narva 6a, Viljandi 6b) and colder inland (Tartu 5a, Valga 5a, Võru 5a).

Latvia's capital Riga is in zone 6b. The country is in zones 5a, 5b, 6a, 6b, 7a and 7b.

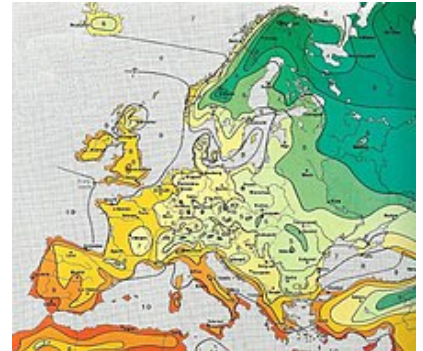
Lithuania's capital Vilnius is in zone 5b. The country is in zones 5b, 6a, 6b and 7a.^[53]



A garden in Simrishamn, southern Sweden.

Central Europe

Central Europe is a good example of a transition from an oceanic climate to a continental climate, which reflects in the tendency of the hardiness zones to decrease mainly eastwards instead of northwards. Also, the plateaus and low mountain ranges in this region have a significant impact on how cold it might get during winter. Generally speaking, the hardiness zones are high considering the latitude of the region, although not as high as Northern Europe with the Shetland Islands where zone 9 extends to over 60°N. In Central Europe, the relevant zones decrease from zone 8 on the Belgian, Dutch, and German North Sea coast, with the exception of some of the Frisian Islands (notably Vlieland and Terschelling), the island of Helgoland, and some of the islands in the Rhine-Scheldt estuary, which are in zone 9, to zone 5 around Suwałki, Podlachia on the far eastern border between Poland and Lithuania. Some isolated, high elevation areas of the Alps and Carpathians may even go down to zone 3 or 4. An extreme example of a cold sink is Funtensee, Bavaria which is at least in zone 3. Another notable example is Waksmund, a small village in the Polish Carpathians, which regularly reaches −35 °C (−31 °F) during winter on calm nights when cold and heavy airmasses from the surrounding Gorce and Tatra Mountains descend down the slopes to this low-lying valley, creating extremes which can be up to 10 °C (18 °F) colder than nearby Nowy Targ or Białka Tatrzańska, which are both higher up in elevation. Waksmund is in zone 3b while nearby Kraków, only 80 km (50 mi) to the north and 300 m (980 ft) lower is in zone 6a. These examples prove that local topography can have a pronounced effect on temperature and thus on what is possible to grow in a specific region.^[60]



Central Europe hardiness zones.^[59]

Southern Europe

The southern European marker plant for climate as well as cultural indicator is the olive tree, which cannot withstand long periods below freezing so its cultivation area matches the cool winter zone. The Mediterranean Sea acts as a temperature regulator, so this area is generally warmer than other parts of the continent; except in mountainous areas where the sea effect lowers, it belongs in zones 8–10; however, southern Balkans (mountainous Western and Eastern Serbia, continental Croatia, and Bulgaria) are colder in winter and are in zones 6–7. The Croatian (Dalmatian) coast, Albania, and northern Greece are in zones 8–9, as are central-northern Italy (hills and some spots in Po Valley are however colder) and southern France; Central Iberia is 8–9 (some highland areas are slightly colder). The Spanish and Portuguese Atlantic coast, much of Andalusia and Murcia, coastal and slightly inland southern Valencian Community, a part of coastal Catalonia, the Balearic Islands, southwestern Sardinia, most of Sicily, coastal southern Italy, some areas around Albania,^{[61][62]} coastal Cyprus and southwestern Greece are in zone 10. In Europe, the zone 11a is limited only to a few spots. In the Iberian Peninsula, it can be found on the southern coast, namely in populated Spanish areas such as the cities of Almería, Adra, Nerja, Málaga, Marbella and in a strip of coastal land between Tarifa and Punta Carnero in the province of Cádiz.^[46] In Portugal, zone 11a can be found in the Southwest on a few unpopulated sites around the municipalities of Lagos and Vila do Bispo.^[63] In Greece, zone 11a can be found in areas of Crete, Karpathos and Antiparos islands.^[64] The Mediterranean islands of Malta, Lampedusa and Linosa belong to zone 11a as well as a few areas on the southernmost coast of Cyprus. The Balkan area is also more prone to

cold snaps and episodes of unseasonable warmth. For instance, despite having similar daily means and temperature amplitudes to Nantucket, Massachusetts, for each month, Sarajevo has recorded below-freezing temperatures in every month of the year.^{[65][66]}

Macaronesia

Macaronesia consists of four archipelagos: The Azores, the Canary Islands, Cape Verde and Madeira. At lower altitudes and coastal areas, the Portuguese Azores and Madeira belong to zones 10b/11b and 11a/11b respectively. The Azores range from 9a to 11b and Madeira ranges from 9b to 12a, 9a and 9b found inland on the highest altitudes such as the Mount Pico in the Azores or Pico Ruivo in Madeira.^[67] The Spanish Canary Islands hardiness zones range from 8a to 12b depending on the location and the altitude. The islands are generally part of zones 11b/12a in lower altitudes and coastal areas, reaching up to 12b in the southernmost coasts or populated coastal parts such as the city of Las Palmas. The lowest hardiness areas are found in Teide National Park being at 8a/8b for its very high altitude. The Teide peak is the highest peak of Macaronesia.^[46]

The Cape Verde islands, located much further south inside the Tropics, have hardiness zones that range from 12 to 13 in the coastal areas, while the lowest hardiness zone is found in the island of Fogo, in the country's highest peak Pico do Fogo.

American Horticultural Society heat zones

In addition to the USDA Hardiness zones there are American Horticultural Society (AHS) heat zones.

The criterion is the average number of days per year when the temperature exceeds 30 °C (86 °F). The AHS Heat Zone Map for the US is available on the American Horticultural Society website.^[68]

| Zone | From | To |
|------|------|-----|
| 1 | < 1 | |
| 2 | 1 | 7 |
| 3 | 8 | 14 |
| 4 | 15 | 30 |
| 5 | 31 | 45 |
| 6 | 46 | 60 |
| 7 | 61 | 90 |
| 8 | 91 | 120 |
| 9 | 121 | 150 |
| 10 | 151 | 180 |
| 11 | 181 | 210 |
| 12 | >210 | |

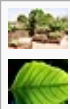
South Africa

South Africa has five horticultural or climatic zones. The zones are defined by minimum temperature.^[69]

Effects of climate change

The USDA map published in 2012 shows that most of the US has become a half zone (2.8 °C or 5 °F) hotter in winter compared to the 1990 release.^[8] Research in 2016 suggests that USDA plant hardiness zones will shift even further northward under climate change.^[70]

See also



[Gardening portal](#)

[Plants portal](#)

- [Agriculture](#)
- [Gardening](#)
- [Geographical zone](#)
- [Hardiness \(plants\)](#)
- [Subtropics](#)

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External links

- Freeze/Frost data from NOAA (<http://www.ncdc.noaa.gov/oa/climate/freezefrost/freezefrost.pdf>)
- Data on plant hardiness in Ireland (https://web.archive.org/web/20110721193555/http://www.earlscliff.e.com/climatic_zone_plants.htm)
- Plant Hardiness Data (<http://www.planthardiness.gc.ca/>) (Canada)
 - Plant Hardiness Zones of Canada – Interactive Map (<http://atlas.agr.gc.ca/agmaf/>)

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