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United States
Department of
Agriculture

Agricultural
Research
Service

Miscellaneous
Publication
Number 1475

USDA Plant Hardiness Zone Map

USDA Plant Hardiness Zone Map

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THIS map supersedes U.S. Department of Agriculture Miscellaneous Publication 814, "Plant Hardiness Zone Map," which was revised in 1965. It shows in detail the lowest temperatures that can be expected each year in the United States, Canada, and Mexico. These temperatures are referred to as "average annual minimum temperatures" and are based on the lowest temperatures recorded for each of the years 1974 to 1986 in the United States and Canada and 1971 to 1984 in Mexico. The map shows 10 different zones, each of which represents an area of winter hardiness for the plants of agriculture and our natural landscape. It also introduces zone 11 to represent areas that have average annual minimum temperatures above 40°F (4.4°C) and that are therefore essentially frost free.

Basic Plant Requirements

All agriculturists, environmentalists, horticulturists, and home gardeners have one all-abiding question about any plant they wish to introduce into their growing spaces. Will it flourish?

The ability to predict whether a newly collected species or cultivar can be successfully grown in a location is fundamental to the continued productivity of America's agriculture and to the survival of our landscapes. The plants in our urban spaces, farms, fields, and forests consist of native vegetation and exotic plants introduced into our land from all over the world. All plants must be placed in an environment that meets their basic requirements:

Day length. Day length is usually the most critical factor in regulating vegetative growth, flower initiation and development, and the induction of dormancy. Plants survive only when the day length promotes their growth and prepares them for the seasonal changes.

Radiation. Most plants respond to radiation in the 270- to 3000-nm region. Cloudy, rainy days coupled with the shade provided by nearby plants and structures can significantly reduce the amount of radiation available. Plants survive only where the amount is within a specified range.

Temperature. Plants grow best within an optimum range of temperatures; and the range may be wide for some species, narrow for others. Plants survive only where temperatures allow them to metabolize.

Frost. Plants differ in ability to survive frost, their responses varying from immediate death to sustained performance. The previous environmental and cultural conditions of plants can often shift, but not permanently alter, their tolerance to freezing. Plants survive only when they are adapted to subfreezing weather.

Director, U.S. National Arboretum, Agricultural Research Service, U.S. Department of Agriculture, Washington, DC 20002. Temperature data were compiled and maps prepared under contract with the Meteorological Evaluation Services Co., Inc., 165 Broadway, Amityville, New York 11701.

Heat. The thermal cutoff temperature varies widely from species to species. By tradition we group plants into sun, partial sun, and shade types and plant them according to their light and heat tolerances.

Rainfall. Gardeners need to know how much water a landscape plant requires in determining its usability in low maintenance landscapes. Rainfall gardening often greatly limits which species can be used successfully. Gardeners also need to know how much and how often to water plants in high maintenance landscapes.

pH. The ability of plant roots to take up water and nutrients depends on the pH (measure of acidity or alkalinity), presence of soluble and insoluble salts, and aeration of the growing medium. The successful culture of all plant species requires that they be grown in a medium within a definite pH range and with from 10 to 14 essential nutrients in appropriate balance. Although plants may tolerate some extraneous elements and compounds, every plant species and cultivar has well-prescribed limits.

How the Map Was Started

Every plant can adapt to a range of environments. Gardeners have learned through experience where the great variety of landscape plants can be grown. Over the years many schemes have been proposed to help gardeners locate those environments when they introduce new species, forms, and cultivars. The pooling of many of these schemes culminated in the development of the widely used "Plant Hardiness Zone Map," under the supervision of Henry T. Skinner, the second director of the U.S. National Arboretum. In cooperation with the American Horticultural Society, he worked with horticultural scientists throughout the United States to incorporate pertinent horticultural and meteorological information into the map.

The elements of that map were—

Zones. The contiguous United States and southern Canada were divided into 10 zones based on a 10°F (5.6°C) difference in average annual minimum temperature.

Winter Hardiness. Survival of landscape plants over winter was selected as the most critical criterion in their adaptation to the environment.

Classification. The zone ratings were intended to indicate *excellent adaptability* of the plants. Many plants may survive in warmer or colder zones. Usually, mere survival does not represent satisfactory performance.

Interactions With Other Environmental Factors. Many other factors may come into play in determining satisfactory growth. Wind, soil type, soil moisture, humidity, snow, and winter sunshine may greatly affect the adaptability of plants.

Interactions With Cultural Factors. The way plants are placed in the landscape, how they are planted, and their size and health can greatly influence satisfactory adaptability.

Why the New Map Was Created

The "Plant Hardiness Zone Map" was published in 1960 and revised in 1965. Since then, many changes, new interests, and new responsibilities have emerged in North American landscaping:

Changes in Weather. We have been losing from our landscapes plants that apparently survived the 1940's to the 1960's. Many of the hardiness zone classifications of plants are no longer considered valid. In North America, the ranges of temperature and moisture for the past decade were wider than those recorded for the 1940's through the 1960's.

Introduction of New Elite Forms. Our landscape industry has worked with plant explorers and breeders to introduce many new forms of traditional plants that are adapted to a wider range of environments than the older forms.

Scope. The continental United States is contiguous with Canada to the north and Mexico to the south. We share more than a common border—we share indigenous plants and many introduced plants that can be grown successfully. We needed to expand the scope to include the whole of North America.

How To Use the New Map

Zones 2-10 in the map have been subdivided into light- and dark-colored sections (a and b) that represent 5°F (2.8°C) differences within the 10°F (5.6°C) zone. The light color of each zone represents the colder section; the dark color, the warmer section. Zone 11 represents any area where the average annual minimum temperature is above 40°F (4.4°C). The map shows 2° latitude and longitude lines. Areas above an arbitrary elevation are traditionally considered unsuitable for plant cropping and do not bear appropriate zone designations. There are also island zones that, because of elevation differences, are warmer or cooler than the surrounding areas and are given a different zone designation. Note that many large urban areas carry a warmer zone designation than the surrounding countryside. The map contains as much detail as possible, considering the vast amount of data on which it is based and its size.

In using the map to select a suitable environment for a landscape plant, today's gardeners should keep in mind the following:

Stress Factors. We became aware of additional stresses to plants during the 1970's. Acid rain, gaseous and particulate pollution, security lighting, and toxic wastes, among many other stress factors, have significantly increased the potential for unsatisfactory performance of landscape plants. We need to document the tolerances of plants to these factors.

New Plant Management Systems. New techniques of planting, transplanting, watering, fertilizing, and providing pest control measures have done much to increase the vigor of landscape plants. But used unwisely, these same measures can reduce plant hardiness.

Artificial Environments. We have pushed the use of plants into totally artificial environments such as expressways, malls, elevated decks, and buildings where plant roots are totally removed from the ground and its warming influence. The assortment of plants that can adapt to such environments is proving to be very restricted. Hardiness ratings alone are inadequate to guide landscapers in selecting the most successful plants.

How the Map Was Created

The average annual minimum temperature data were analyzed for Mexico, the United States, and Canada. Of 14,500 stations that measured temperature during the period of interest, almost 8,000 could be identified by latitude and longitude and by a valid average annual minimum temperature (i.e., an average based on at least 10 years of data). Data from only the latter stations were used in the map. The data were archived by Servicio Meteorologico Nacional (Tucubaya, D.F., Mexico), the National Climatic Data Center (Asheville, NC), and Environment Canada - Canadian Climate Centre (Downsview, Ontario). The map is an Albers Equal Area Projection. Standard parallels of 29.5° and 45.5° were used to generate the map of the three countries. The map was computer generated by latitude and longitude. Because of the large area involved, it is not possible to draw one map that is accurate for all of North America. The part representing the United States has the least distortion. The Agricultural Research Service proposes to periodically evaluate weather data and issue updated maps as necessary and appropriate.

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Indicator Plant Examples

Following are names of representative persistent plants listed under the coldest zones in which they normally succeed. Such plants may serve as useful indicators of the cultural possibilities of each zone.

Zone	Botanical Name	Common Name
1	<i>Betula glandulosa</i>	Dwarf birch
	<i>Empetrum nigrum</i>	Crowberry
	<i>Populus tremuloides</i>	Quaking aspen
°F Below -50	<i>Potentilla pensylvanica</i>	Pennsylvania cinquefoil
°C Below -45.6	<i>Rhododendron lapponicum</i>	Lapland rhododendron
	<i>Salix reticulata</i>	Netleaf willow
2	<i>Betula papyrifera</i>	Paper birch
	<i>Cornus canadensis</i>	Bunchberry dogwood
	<i>Elaeagnus commutata</i>	Silverberry
°F -50 to -40	<i>Larix laricina</i>	Eastern larch
°C -45.6 to -40	<i>Potentilla fruticosa</i>	Bush cinquefoil
	<i>Viburnum trilobum</i>	American cranberry bush
3	<i>Berberis thunbergii</i>	Japanese bayberry
	<i>Elaeagnus angustifolia</i>	Russian olive
	<i>Juniperus communis</i>	Common juniper
°F -40 to -30	<i>Lonicera tatarica</i>	Tatarian honeysuckle
°C -40 to -34.5	<i>Malus baccata</i>	Siberian crabapple
	<i>Thuja occidentalis</i>	American arborvitae
4	<i>Acer saccharum</i>	Sugar maple
	<i>Hydrangea paniculata</i>	Panicle hydrangea
	<i>Juniperus chinensis</i>	Chinese juniper
°F -30 to -20	<i>Ligustrum amurense</i>	Amur River privet
°C -34.5 to -28.9	<i>Parthenocissus quinquefolia</i>	Virginia creeper
	<i>Spiraea x vanhouttei</i>	Vanhoutte spirea
5	<i>Cornus florida</i>	Flowering dogwood
	<i>Deutzia gracilis</i>	Slender deutzia
	<i>Ligustrum vulgare</i>	Common privet
°F -20 to -10	<i>Parthenocissus tricuspidata</i>	Boston ivy
°C -28.9 to -23.3	<i>Rosa multiflora</i>	Japanese rose
	<i>Taxus cuspidata</i>	Japanese yew

Zone	Botanical Name	Common Name
6	<i>Acer palmatum</i>	Japanese maple
°F -10 to 0	<i>Buxus sempervirens</i>	Common box
°C -23.3 to -17.8	<i>Euonymus fortunei</i>	Winter creeper
	<i>Hedera helix</i>	English ivy
	<i>Ilex opaca</i>	American holly
	<i>Ligustrum ovalifolium</i>	California privet
7	<i>Acer macrophyllum</i>	Bigleaf maple
°F 0 to 10	<i>Rhododendron Kurume</i> hybrids	Kurume azalea
°C -17.8 to -12.3	<i>Cedrus atlantica</i>	Atlas cedar
	<i>Cotoneaster microphylla</i>	Small-leaf cotoneaster
	<i>Ilex aquifolium</i>	English holly
	<i>Taxus baccata</i>	English yew
8	<i>Arbutus unedo</i>	Strawberry tree
°F 10 to 20	<i>Choisya ternata</i>	Mexican orange
°C -12.3 to -6.6	<i>Olearia haastii</i>	New Zealand daisy-bush
	<i>Pittosporum tobira</i>	Japanese pittosporum
	<i>Prunus laurocerasus</i>	Cherry-laurel
	<i>Viburnum tinus</i>	Laurestinus
9	<i>Asparagus setaceus</i>	Asparagus fern
°F 20 to 30	<i>Eucalyptus globulus</i>	Tasmanian blue gum
°C -6.6 to -1.1	<i>Syzygium paniculatum</i>	Australian bush cherry
	<i>Fuchsia</i> hybrids	Fuchsia
	<i>Grevillea robusta</i>	Silk-oak
	<i>Schinus molle</i>	California pepper tree
10	<i>Bougainvillea spectabilis</i>	Bougainvillea
°F 30 to 40	<i>Cassia fistula</i>	Golden shower
°C -1.1 to 4.4	<i>Eucalyptus citriodora</i>	Lemon eucalyptus
	<i>Ficus elastica</i>	Rubber plant
	<i>Ensete ventricosum</i>	Ensete
	<i>Roystonea regia</i>	Royal palm

Cold Hardiness Ratings
for Some Additional
Woody Plants

Botanical and Common Names	Zone
<i>Abeliophyllum distichum</i> (white forsythia)	5b
<i>Acer platanoides</i> (Norway maple)	4
<i>Aesculus x carnea</i> (red horsechestnut)	4
<i>Araucaria araucana</i> (monkeypuzzle)	7b
<i>Arctostaphylos uva-ursi</i> (bearberry)	2b
<i>Aristolochia durior</i> (Dutchman's-pipe)	4b
<i>Aucuba japonica</i> (Japanese aucuba)	7b
<i>Bauhinia variegata</i> (purple orchid tree)	9b
<i>Berberis darwinii</i> (Darwin barberry)	8
<i>Betula pendula</i> (European white birch)	3
<i>Bouvardia</i> 'Coral' (Coral bouvardia)	9
<i>Butia capitata</i> (Pindo palm)	8b
<i>Camellia reticulata</i> (<i>reticulata camellia</i>)	9
<i>Camellia sasanqua</i> (<i>sasanqua camellia</i>)	7b
<i>Carya illinoensis</i> 'Major' (pecan)	{ 5 (grows) 6 (fruits)
<i>Casuarina equisetifolia</i> (Australian pine)	9b
<i>Ceanothus impressus</i> (Santa Barbara ceanothus)	8
<i>Cedrus deodara</i> (deodar cedar)	7b
<i>Cercis chinensis</i> (Chinese redbud)	6b
<i>Chamaecyparis lawsoniana</i> (Lawson cypress)	6b
<i>Chamaecyparis pisifera</i> (Sawara cypress)	5
<i>Cinnamomum camphora</i> (camphor tree)	9
<i>Cistus laurifolius</i> (laurel rockrose)	7
<i>Cistus x purpureus</i> (purple rockrose)	8
<i>Cornus alba</i> (Tatarian dogwood)	3
<i>Cornus kousa</i> (Japanese dogwood)	5b
<i>Cunninghamia lanceolata</i> (cunninghamia)	7
<i>Cytisus x praecox</i> (Warminster broom)	6

Botanical and Common Names	Zone
<i>Elaeagnus multiflora</i> (cherry elaeagnus)	5
<i>Elaeagnus pungens</i> (thorny elaeagnus)	7
<i>Eriobotrya japonica</i> (loquat)	8
<i>Euonymus alatus</i> (winged euonymus)	3b
<i>Euphorbia pulcherrima</i> (poinsettia)	10
x <i>Fatsyhedera lizei</i> (botanical-wonder)	8
<i>Forsythia ovata</i> (early forsythia)	4b
<i>Forsythia suspensa</i> (weeping forsythia)	5b
<i>Fremontodendron mexicanum</i> (flannel bush)	9
<i>Ginkgo biloba</i> (ginkgo, maidenhair-tree)	5
<i>Hibiscus rosa-sinensis</i> (Chinese hibiscus)	9b
<i>Hibiscus syriacus</i> (shrub althea)	5b
<i>Hypericum</i> 'Hidcote' (Hidcote St. Johnswort)	6
<i>Iberis sempervirens</i> (evergreen candytuft)	5
<i>Ilex crenata</i> 'Convexa' (convexleaf Japanese holly)	6b
<i>Jacaranda acutifolia</i> (green ebony)	10
<i>Juglans regia</i> (English or Persian walnut)	6b
<i>Juniperus horizontalis</i> (creeping juniper)	3
<i>Koelreuteria paniculata</i> (goldenrain-tree)	6
<i>Laburnum</i> x <i>watereri</i> (Waterer laburnum)	5b
<i>Lagerstroemia indica</i> (crapemyrtle)	7
<i>Mahonia aquifolium</i> (Oregon hollygrape)	5b
<i>Malus</i> x <i>arnoldiana</i> (Arnold crabapple)	4
<i>Melia azedarach</i> (chinaberry)	7b
<i>Metasequoia glyptostroboides</i> (dawn redwood)	5b
<i>Myrtus communis</i> (true myrtle)	8b
<i>Nandina domestica</i> (heavenly bamboo)	7
<i>Nerium oleander</i> (oleander)	8b

Botanical and Common Names	Zone
<i>Olea europaea</i> (common olive)	9
<i>Osmanthus heterophyllus</i> (holly osmanthus)	7
<i>Picea abies</i> (Norway spruce)	3
<i>Pieris japonica</i> (Japanese andromeda)	6
<i>Pinus mugo</i> var. <i>mughus</i> (Mugo pine)	3
<i>Pinus radiata</i> (Monterey pine)	7b
<i>Pinus strobus</i> (eastern white pine)	3b
<i>Prunus yedoensis</i> (Yoshino cherry)	6
<i>Raphiolepis indica</i> 'Rosea' (Indian hawthorn)	8
<i>Rhododendron</i> 'America' (hybrid rhododendron)	5
<i>Rhododendron</i> 'Loderi King George' (hybrid rhododendron)	8
<i>Rhododendron mollis</i> hybrids (mollis azalea)	5
<i>Rhododendron prinophyllum</i> (roseum) (roseshell azalea)	4
<i>Rhododendron</i> 'Purple Splendor' (hybrid rhododendron)	7
<i>Rhododendron</i> southern Indian hybrids (Indian azalea)	8b
<i>Rosa rugosa</i> (rugosa rose)	3
<i>Schinus terebinthifolius</i> (Brazilian pepper-tree)	9b
<i>Sequoia sempervirens</i> (redwood)	8
<i>Sequoiadendron giganteum</i> (giant sequoia)	7
<i>Stewartia pseudocamellia</i> (Japanese stewartia)	6
<i>Syringa vulgaris</i> (common lilac)	3b
<i>Ulmus americana</i> (American elm)	2
<i>Viburnum burkwoodii</i> (Burkwood viburnum)	5b
<i>Zelkova serrata</i> (Japanese zelkova)	5b

USDA Plant Hardiness Zone Map

The zones of plant hardiness in the United States—This map is an adaptation of the color map on the reverse side. It lacks many fine details of the color map but may be useful for small-scale reproduction in books, magazines, and nursery catalogs.

RANGE OF AVERAGE ANNUAL MINIMUM TEMPERATURES FOR EACH ZONE

ZONE 1	BELOW -50°F	
ZONE 2	-50° TO -40°	
ZONE 3	-40° TO -30°	
ZONE 4	-30° TO -20°	
ZONE 5	-20° TO -10°	
ZONE 6	-10° TO 0°	
ZONE 7	0° TO 10°	
ZONE 8	10° TO 20°	
ZONE 9	20° TO 30°	
ZONE 10	30° TO 40°	
ZONE 11	ABOVE 40°

USDA Plant Hardiness Zone Map

AVERAGE ANNUAL MINIMUM TEMPERATURE

Temperature (°C)	Zone	Temperature (°F)
-45.6 and Below	1	Below -50
-42.8 to -45.5	2a	-45 to -50
-40.0 to -42.7	2b	-40 to -45
-37.3 to -40.0	3a	-35 to -40
-34.5 to -37.2	3b	-30 to -35
-31.7 to -34.4	4a	-25 to -30
-28.9 to -31.6	4b	-20 to -25
-26.2 to -28.8	5a	-15 to -20
-23.4 to -26.1	5b	-10 to -15
-20.6 to -23.3	6a	-5 to -10
-17.8 to -20.5	6b	0 to -5
-15.0 to -17.7	7a	5 to 10
-12.3 to -15.0	7b	10 to 15
-9.5 to -12.2	8a	15 to 20
-6.7 to -9.4	8b	20 to 25
-3.9 to -6.6	9a	25 to 30
-1.2 to -3.8	9b	30 to 35
1.6 to -1.1	10a	35 to 40
4.4 to 1.7	10b	40 to 45
4.5 and Above	11	45 and Above

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