

CLIMATE CHANGE VULNERABILITY OF URBAN TREES

DES MOINES, IOWA



This list was developed to aid Des Moines, Iowa, community forestry practitioners in selecting trees to reduce climate change vulnerability of their urban forests. It is meant to complement other tree selection resources. When reviewing this list, other factors may also need to be considered, such as tree aesthetics, local site conditions, wildlife value, or nursery availability. It is also important to note that some species may have climate benefits but may not be suitable for planting for other reasons, such as having invasive potential or susceptibility to pests or pathogens.



Vulnerability: Trees can be vulnerable to a variety of climate-related stressors such as intense heat, drought, flooding, and changing pest and disease patterns. Climate vulnerability is a function of the impacts of climate change on a tree species and its adaptive capacity. In this list, species that may have anticipated negative impacts from a changing climate and have low adaptive capacity will have high vulnerability and vice versa. **The following factors were used to determine tree species climate vulnerability:**

Urban adaptability: Adaptability scores were generated for each tree species based on literature describing its tolerance to disturbances such as drought, flooding, pests, and disease, as well as its growth requirements such as shade tolerance, soil needs, and ease of nursery propagation. Scores were assigned to species using methods developed in an urban forest vulnerability assessment for Chicago derived for trees planted in developed sites. A **positive score** indicates that a species is tolerant to a wide range of disturbances and can be planted on a variety of sites. A **negative score** indicates a species is highly susceptible to disturbances and/or is limited to specific planting site conditions.

Hardiness and heat zone suitability: Tree species ranges were gathered from government, university, and arboretum websites. Species tolerance ranges were compared to current and projected heat and hardiness zones for Des Moines, IA, using downscaled climate models under low emissions (RCP 4.5) and high emissions (RCP 8.5) scenarios for changes in greenhouse gases. Trees were considered to have suitability if the species' tolerance was within the range of current and projected hardiness and heat zone through the end of the 21st century.

NOTE: This list was primarily created for species planted in developed sites, such as streets, yards, boulevards, and parks. Find projected changes in habitat suitability for native species in natural areas at the Climate Change Tree Atlas website, www.fs.fed.us/nrs/atlas/.

Current and projected USDA Hardiness Zones and AHS Heat Zones for Des Moines, Iowa. Hardiness zone is determined by the average lowest temperature over a 30 year period. Heat zones are determined by the number of days above 86°F.

Time Period	Hardiness Zone Range		Heat Zone Range	
	Low Emissions	High Emissions	Low Emissions	High Emissions
1980–2010	5		6	
2010–2039	5	6	7	7
2040–2069	5 to 6	6	7 to 8	8
2070–2099	6	7	8	9

SOURCE: Adaptability scores were assigned using methods developed in an urban forest vulnerability assessment for Chicago by Brandt et al. 2017 (https://www.fs.fed.us/nrs/pubs/gtr/gtr_nrs168.pdf). Future heat and hardiness zone information were provided from: <https://usfs.maps.arcgis.com/apps/MapSeries/index.html?appid=96088b1c086a4b39b3a75d0fd97a4c40>.



URBAN ADAPTABILITY:

- + **High:** Species may perform better than modeled
- **Medium**
- **Low:** Species may perform worse than modeled

ZONE SUITABILITY:

- ✓ **Suitable**
- ✗ **Not Suitable**

VULNERABILITY:

- ▼ **Low:** Suitable zone, high adaptability
- **Low-moderate:** Suitable zone, medium adaptability
- ⊖ **Moderate:** Suitable zone, low adaptability or zone not suitable, high adaptability
- **Moderate-high:** Zone not suitable, medium adaptability
- △ **High:** Zone not suitable, low adaptability

*Invasive species

COMMON NAME	LOW EMISSIONS					HIGH EMISSIONS				
	ADAPT	ZONE SUIT	VULN	ZONE SUIT	VULN	ADAPT	ZONE SUIT	VULN	ZONE SUIT	VULN
American bladdernut		✓		✗						
American elm	•	✓	●	✓	●					
American holly	+	✓	▼	✓	▼					
American linden, Basswood	+	✓	▼	✗	⊖					
American sycamore	•	✓	●	✓	●					
Amur maackia	+	✗	⊖	✗	⊖					
Bald cypress	+	✓	▼	✓	▼					
Balsam fir	•	✗	○	✗	○					
Black oak	-	✓	⊖	✗	△					
Black tupelo, Black gum	+	✓	▼	✓	▼					
Black willow	-	✓	⊖	✓	⊖					
Blackhaw	+	✓	▼	✓	▼					
Blue spruce	•	✓	●	✗	○					
Bur oak	+	✓	▼	✓	▼					
Chinkapin oak	+	✓	▼	✗	⊖					
Cockspur hawthorn	•	✗	○	✗	○					
Common hackberry	+	✓	▼	✓	▼					
Common horsechestnut	•	✓	●	✗	○					
Common persimmon	+	✓	▼	✓	▼					
Crabapple	•	✓	●	✗	○					
Cucumber tree	•	✓	●	✗	○					
Downy serviceberry	+	✓	▼	✓	▼					
Eastern hemlock	-	✓	⊖	✗	△					
Eastern redbud	•	✓	●	✓	●					
Eastern redcedar	+	✓	▼	✓	▼					
Eastern white pine	-	✗	△	✗	△					
European larch	•	✗	○	✗	○					
Gingko	+	✓	▼	✓	▼					
Hardy rubber tree	+	✗	⊖	✗	⊖					
Honeylocust	•	✓	●	✓	●					
Ironwood	+	✓	▼	✓	▼					
Japanese pagoda tree	+	✓	▼	✓	▼					
Japanese tree lilac	+	✗	⊖	✗	⊖					
Katsura tree	-	✓	⊖	✗	△					
Kentucky coffeetree	+	✓	▼	✓	▼					
Littleleaf linden	+	✗	⊖	✗	⊖					
London planetree	•	✓	●	✓	●					
Mockernut hickory	•	✓	●	✓	●					
Northern red oak	•	✓	●	✓	●					
Norway spruce*	•	✗	○	✗	○					
Ohio buckeye	•	✗	○	✗	○					
Pagoda dogwood	•	✓	●	✗	○					
Persian ironwood	+	✓	▼	✗	⊖					
Red horsechestnut	•	✓	●	✗	○					
River birch	•	✓	●	✓	●					
Sassafras	•	✓	●	✓	●					
Sawtooth oak	+	✓	▼	✗	⊖					
Shagbark hickory	-	✓	⊖	✗	△					
Shingle oak	+	✓	▼	✗	⊖					
Silver linden	•	✓	●	✓	●					
Sourwood	+	✓	▼	✓	▼					
Swamp white oak	+	✓	▼	✗	⊖					
Sweetgum	-	✓	⊖	✓	⊖					
Tamarack	•	✗	○	✗	○					
Tuliptree	-	✓	⊖	✓	⊖					
Turkish hazelnut	+	✗	⊖	✗	⊖					
White fir	•	✗	○	✗	○					
White oak	-	✓	⊖	✗	△					
White spruce	•	✗	○	✗	○					
Winter king green hawthorn	•	✗	○	✗	○					
Witchhazel	•	✓	●	✗	○					
Yellowwood	+	✓	▼	✓	▼					

