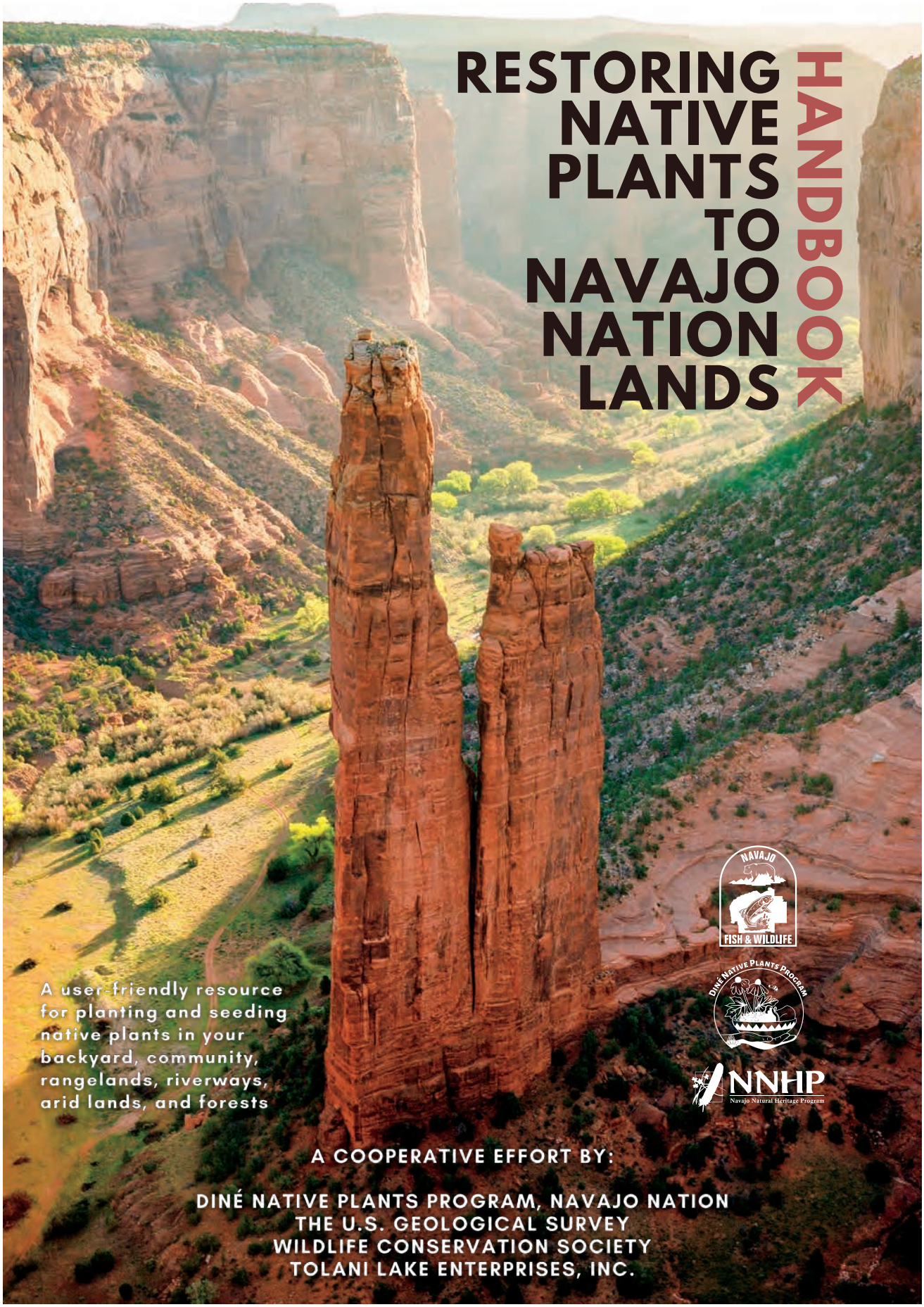

RESTORING NATIVE PLANTS TO NAVAJO NATION LANDS

HANDBOOK

A user-friendly resource for planting and seeding native plants in your backyard, community, rangelands, riverways, arid lands, and forests

NAVAJO FISH & WILDLIFE

DINÉ NATIVE PLANTS PROGRAM

NNHP Navajo Natural Heritage Program

A COOPERATIVE EFFORT BY:

DINÉ NATIVE PLANTS PROGRAM, NAVAJO NATION
THE U.S. GEOLOGICAL SURVEY
WILDLIFE CONSERVATION SOCIETY
TOLANI LAKE ENTERPRISES, INC.

Authors

Jesse Mike, Program Coordinator, Diné Native Plants Program
Nora Ventrella, Botanist, Navajo Natural Heritage Program
Molly L. McCormick, U.S. Geological Survey

Design By

Janelle Josea, Planner, Diné Native Plants Program

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Diné Native Plants Program
Mission Statement

To serve as a living library of native plants for restoration, conservation, and research and to provide Diné people with access to locally-sourced high-quality plants for the benefit of the community, culture, wildlife, and land.

Diné Native Plants Program
Contact Information:

www.nndfw.org/dnpp/homepage.html
Navajo Nation Department of Fish & Wildlife
Indian Route 100, 1 Morgan Blvd
Window Rock, AZ 86515
(928) 871-6450
jmike@nndfw.org

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INTRODUCTION

The Navajo Nation and the greater Southwest are enduring the worst drought in 1200 years (Williams et al. 2022). Current predictions indicate that the Southwest can expect to endure hotter temperatures, drought, and more erratic rainfall and snow. These changes are already impacting rangelands and vegetation communities. Degraded plant communities and bare soils not only mean less forage for livestock and wildlife, but also decreased soil water retention and increased soil erosion. Dust that comes from bare soils degrades air quality, creates roadway hazards, mobilizes sand dunes, and drives ecological change. Extreme summer precipitation causes erosion that removes scarce topsoil, fills earthen stock ponds with sediment, and incises waterways. Poor soil and vegetation management practices of the last century are now interacting with climate change to have detrimental effects on ecosystem function, human health, and economic well-being.

The Navajo Nation is a working landscape that has supported culturally important grazing operations, wildlife habitat, hunting/gathering, ceremony, medicine, art, and agriculture of the Diné People for millennia. Now, in modern times, the Diné People, facing unprecedented drought, introduced invasive species, and a century of natural resource mismanagement, are having to adapt or lose their way of life. In their lifetimes, elders have observed an increasing scarcity of culturally important plants and an increase in drought-tolerant weedy species such as camelthorn, locoweed, and tumbleweed. Thankfully, the Diné, like many tribes in the Southwest, are incredibly resilient, and over time have adapted their way of life and use of the land to changes in conquest, occupation, technology, and climate. Many land users on the Navajo Nation are recognizing the issues facing the Navajo Nation and are taking action to revitalize the important plant communities and ecosystems. Many ranchers are reducing their herds significantly to allow the land and vegetation to rest. Others are constructing small wood, stone, and earthen dams to slow water run-off, decrease erosion, and increase infiltration in our waterways. Still others are attempting to bring native plants back to the landscape through seeding or transplanting in places where remaining native vegetation is unable to naturally return.

Ecological restoration in the arid Southwest region can be expensive and challenging. Methods to improve dryland restoration success have been developed over time and are continually being expanded; however, this information rarely makes it to Navajo land users. The goal of this document is to improve restoration success here on the Navajo Nation by providing Navajo land users an introduction to current seeding and planting techniques, and a tool to select the appropriate native plant species for their unique areas. Restoration and changes in land management practices are critical to a thriving future for the Diné. Adapting cultural practices must come from the hearts and hands of the people through ongoing practices and relationships based on cultural, ecological, and economic resilience. This handbook is not a solution to all the barriers to restoration in the arid southwest but can serve as a guide to reseeding diverse and resilient plant populations with the capacity to cope with ever-changing conditions expected from climate change.

What Is This Tool?

Seeds and plants can be expensive; and whether you are a rancher looking to improve grass production for livestock, a land manager looking to keep invasive weeds from taking over, or a homeowner with a 1-acre homesite looking for flowers near the house or a windbreak, choosing the right plant for the right place can be hard! It's easy to waste time and money on plants that aren't adapted to the dry summers and cold winters that are common out here on the Navajo Nation. For a challenging climate, we need native plants that are adapted to survive and thrive in our unique conditions without requiring lots of supplemental water and fertilizer.

Native plants, like native peoples, have evolved with the high desert climate and are adapted to this specific place. Native plants form the foundation of an ecosystem that supports an extremely diverse food web of insects, fungi, soil organisms, invertebrates, mammals, and birds; all of which have co-evolved over millennia to form complex networks and interactions. When you put a native plant back on the landscape, you are helping to support and strengthen these networks.

This handbook serves as a general resource to guide native plant decision-making for anyone to use on the Navajo Nation. In this handbook we cover:

1. Descriptions of the various ecoregions across the Navajo Nation.
2. Descriptions of diverse native plants for various uses.
3. Information on acquiring native seed.
4. Tips for planting and seeding success.

Who is this handbook for?

The short answer is anyone! Anyone looking to bring native plants back to their homesite, or grazing lands, or chapter, or streambank. Anyone who sees a patch of Russian knapweed and wants to convert that patch back to a native vegetation community. Anyone looking for a low-water and low-maintenance flower patch near their hogan to provide beauty, shade, and food for native bees and butterflies. Anyone who wants to bring the bunchgrasses back to rangelands to hold the soils in place and provide forage for Navajo elk and deer herds.

GETTING TO KNOW YOUR SITE

The first step in any restoration or re-vegetation project is to know your site. Whether it's your homesite, grazing lands, chapter, or streambank; it's essential to have a general understanding of your soil type, elevation, landform, and existing vegetation. These basic characteristics will determine what native plants will have the best chance of survival in your area and prevent you from losing time and money on failed restoration projects. Below are resources to help you get to know your site, if you can find your general location on a map, these resources will provide you with a wealth of information and will bring you one step closer to successfully bringing native plants back to your site.

Northern Arizona Life Zones

Patterns in vegetation are largely dictated by temperature and precipitation regimes, which can be predicted by elevation. In general, as you move higher in elevation the average temperature becomes cooler and precipitation increases. The plant communities that you find in the Chuska Mountains are going to be similar to the plants you find at the same elevation on Black Mesa because of similar temperature and precipitation. This idea of elevation defined vegetation types is commonly called the life or vegetation zone concept. The following graph (Figure 1), taken from "Field Guide to Forest and Mountain Plants of Northern Arizona" (Springer et al. 2009), shows the elevations of Northern Arizona and the associated life zone. Although these zones are named for the dominant vegetation in that elevation range, many of the other plant species will overlap with these zones. For instance, muttongrass will primarily grow in the Pinyon-Juniper Woodland and Ponderosa Pine Forest zone. Many of the restoration and plant resources in our region, including this one, will refer to these life zones, so it is useful to know the elevation of your home, rangeland, or restoration site, and what life zone(s) it falls in.

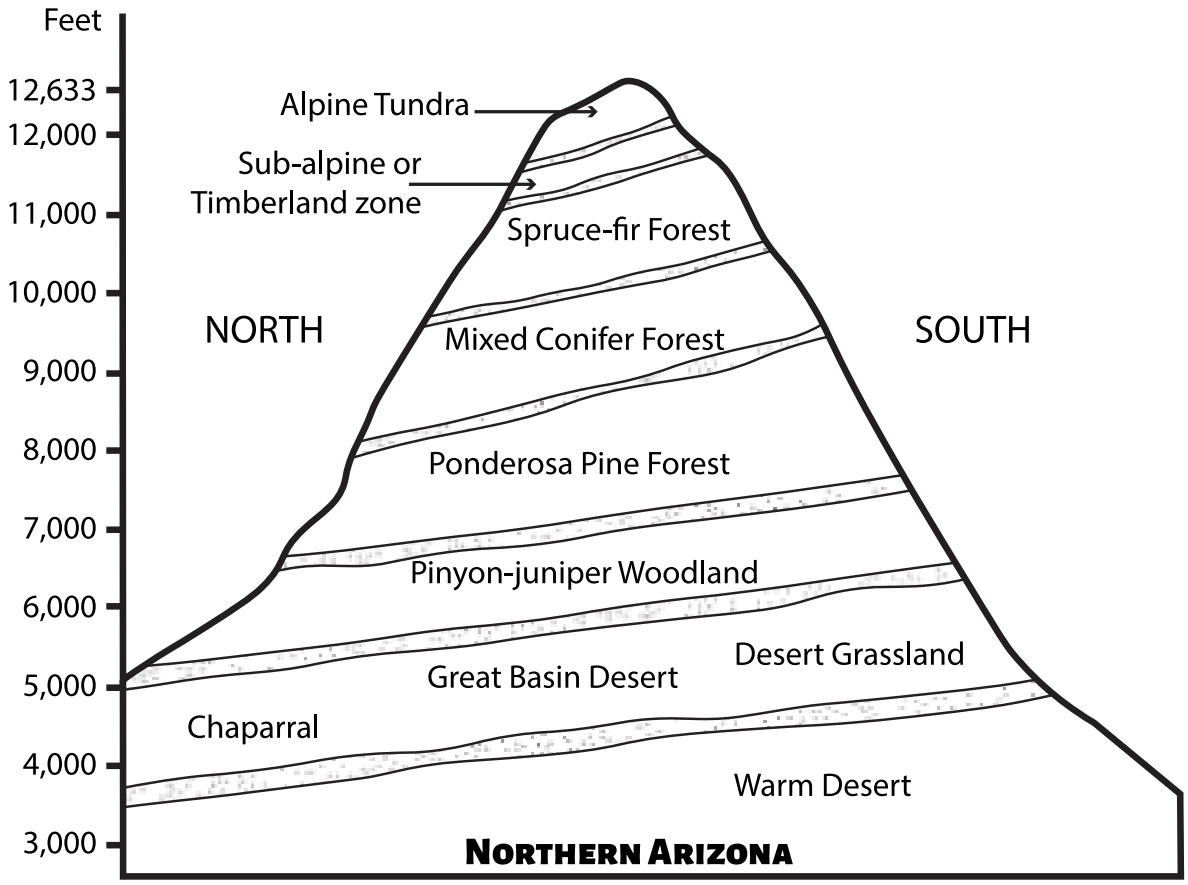


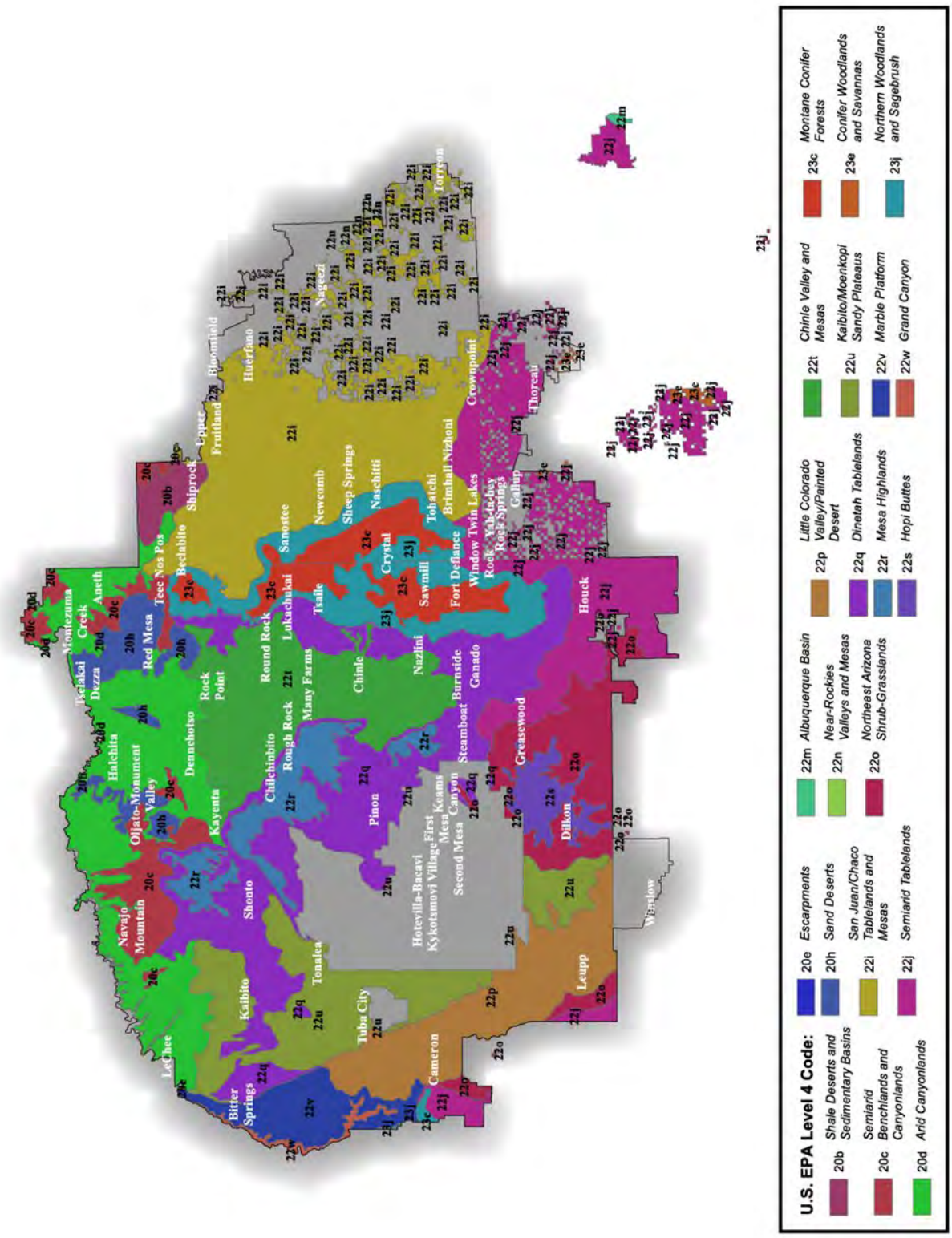
Figure 1. Life Zones of Northern Arizona based on elevation and aspect (northern aspects are generally cooler/wetter and southern warmer/drier). Life Zones are grouped based on dominant vegetation types; however, many minor species will follow these same zones.

Table 1. Select Navajo Nation elevations. Elevation can be a good predictor of the type of vegetation in your area. Use elevation, life zone, and on-site observations to select native species to plant or seed.

Location	Elevation (ft)	Location	Elevation (ft)
Cameron	4,203	Shonto	6,240
Oljato	4,838	Standing Rock	6,330
Mexican Water	4,842	Piñon	6,350
Shiprock	4,892	Black Mesa	6,435
Tuba City	4,961	Pueblo Pintado	6,512
Bird Springs	5,203	Oak Springs	6,665
Round Rock	5,350	Chichiltah	6,762
Burnham	5,430	Ramah	6,926
Chinle	5,506	Sawmill	6,975
Tonalea	5,650	Pinedale	7,010
Red Valley	5,797	Gray Mountain	7,050
Greasewood Springs	5,910	Mariano Lake	7,129
Coppermine	6,000	Tsaile/Wheatfields	7,142
Nahat'a'dziil	6,030	Fluted Rock (Defiance Plateau)	8,304
Alamo	6,184	Pastora Peak (Carrizo Mountains)	9,413
Huerfano	6,194	Roof Butte (Chuska Mountains)	9,787
Tohajiilee	6,213	Navajo Mountain	10,348

Navajo Nation Ecoregions

Ecoregions are areas of similarity that are grouped together by factors such as geology, landform, elevation, soil, vegetation, climate, wildlife, water, and human use. The U.S. Environmental Protection Agency (EPA) developed a hierarchical mapping framework for land classification in North America. The classification has 4 levels: Level 1 is the coarsest, dividing North America into 15 ecological regions, and Level 4 is the most detailed, dividing North America into 967 regions. The map and descriptions below correspond to EPA Level 4 Ecoregions of the Navajo Nation, of which there are 20. These descriptions can be useful when deciding which species to include in a restoration seeding mix or revegetation project for your project site and are a good place to start. However, be aware that your site might contain local variation in elevation, soils, climate, or topography that more closely resembles the vegetation community of another ecoregion. It is always good practice to visit your project site in-person and observe which native species are occurring nearby. Taking good notes on which species are present as well as soil type (sandy, silty, or clayey), and the amount of solar exposure your site receives (for example, forest understory, partial shade, or full-sun), can be invaluable information for selecting your species mix.


U.S. EPA Level 4 Code:
20b Shale Deserts and Sedimentary Basins
20c Semiarid Benchlands and Canyonlands
20d Arid Canyonlands
20e Escarpments
20h Sand Deserts
22i San Juan/Chaco Tablelands and Mesas
22j Semiarid Tablelands
22m Albuquerque Basin
22n Near-Rockies Valleys and Mesas
22o Northeast Arizona Shrub-Grasslands
22p Little Colorado Valley/Painted Desert
22q Dinetah Tablelands
22r Mesa Highlands
22s Hopi Buttes
22t Chinle Valley and Mesas
22u Kaibito/Moenkopi Sandy Plateaus
22v Marble Platform
22w Grand Canyon
23c Montane Conifer Forests
23e Conifer Woodlands and Savannas
23j Northern Woodlands and Sagebrush

20b: Shale Deserts and Sedimentary Basins (1% of the Navajo Nation)

The arid **Shale Deserts and Sedimentary Basins** ecoregion consists of nearly level basins and valleys, benches, low rounded hills, and badlands. Rock outcrops occur; it is sparsely vegetated with mat saltbush, fourwing saltbush, greasewood, and shadscale. Native grasses include alkali sacaton, galleta grass, poverty threeawn, sand dropseed, and Indian ricegrass. It is lower in elevation with less pinyon-juniper woodland than the adjacent Semiarid Benchlands and Canyonlands (20c). This ecoregion covers 5% of Shiprock agency.

20c: Semiarid Benchlands and Canyonlands (3% of the Navajo Nation)

Broad, grass-, shrub-, and woodland-covered benches and mesas characterize the **Semiarid Benchlands and Canyonlands** ecoregion. Areas of high relief alternate with areas of low relief. Low escarpments separate remnant mesa tops and narrow canyons from surrounding benches. In Arizona, elevations range mostly from 5000 to over 7300 feet, higher than those of adjacent ecoregions 20d or 20i. Bedrock exposures (e.g., slickrock and fins) are common along rims, escarpments, and on steep dip slopes. Deep eolian soils are composed of fine sand and support warm season grasses, winterfat, Mormon tea, fourwing saltbush, and sagebrush. Pinyon and juniper occur on shallow, stony soils. Scattered areas of Gambel oak occur at higher elevations. Fire suppression and erosion have allowed this woodland to expand beyond its original range. The vegetation is not as sparse as in drier areas such as Ecoregions 20d, 20h, and 20i. Annual precipitation in the Arizona portion varies from 8 to 16 inches. Livestock grazing, recreation, and wildlife habitat are dominant land uses. This ecoregion covers 7% of Shiprock and 5% of Western Navajo agencies.

20d: Arid Canyonlands (9% of the Navajo Nation)

Occurring primarily in Utah, the **Arid Canyonlands** ecoregion includes the inner gorge of the Colorado River and its major tributaries, such as the San Juan River. Much of this ecoregion is bounded by nearly vertical canyon walls that separate it from the adjacent, higher benchlands of Ecoregion 20c. The Arizona portion lacks the relief of most of the region in Utah. Soils have a drier moisture regime than those of Ecoregions 20c. Exposed bedrock is common. Blackbrush, shadscale, some sand sagebrush, and drought-tolerant grasses including galleta grass and Indian ricegrass occur. Blackbrush is more common here than in Ecoregion 20c where pinyon-juniper woodland and sagebrush dominate. Annual precipitation in the Arizona portion is 5 to 8 inches. Land use is mostly related to tourism and recreation, wildlife habitat, and some livestock grazing. This

ecoregion covers 16% of Shiprock and 16% of Western Navajo agencies.

20e: Escarpments (<1% of the Navajo Nation)

The **Escarpments** ecoregion is characterized by extensive, deeply-dissected, cliff-bench complexes that descend dramatically from Ecoregion 20c or in Utah from the Wasatch Mountains of Ecoregion 19. Local relief can be as great as 3000 feet. Ecoregion 20e includes major scarp slopes of the Tavaputs Plateau, Book Cliffs, and the Grand Staircase in Utah, the Roan Cliffs in Colorado, and the Vermilion Cliffs and Paria Canyon in Arizona. Natural vegetation ranges from conifer forest at higher elevations to desert and semi-desert grassland or shrubland on lower, drier sites. Pinyon-juniper woodland often dominates escarpments and benches that are covered by shallow soils. This rugged, remote, and varied landscape provides habitat for wildlife and scenic landscapes for tourism and recreation. This ecoregion covers <1% of both the Western Navajo and Shiprock agencies.

20h: Sand Desert (2% of the Navajo Nation)

The **Sand Deserts** ecoregion of southern Utah and northern Arizona is in nearly level to irregular basins and contains a mantle of sandy eolian deposits, shifting dunes, and exposed sandstone bedrock. Entisols and Aridisols are common. The soils are sandy and have a low water holding capacity. They have a drier moisture regime than the soils of Ecoregions 20c. On average, they receive only 6 to 9 inches of precipitation annually in the east and up to 13 inches in the areas west of Fredonia. Vegetation is sparser than in Ecoregion 20c and stock carrying capacity is limited. Shifting sand is mostly devoid of vegetation while soils on stable sand-blankets support drought-tolerant plants including Indian ricegrass, sand dropseed, yucca, and blackbrush. This ecoregion covers 12% of Western Navajo and 10% of Shiprock agencies

22i: San Juan/Chaco Tablelands and Mesas (19% of the Navajo Nation)

The **San Juan/Chaco Tablelands and Mesas** ecoregion of plateaus, valleys, and canyons contains a mix of desert scrub, semi-desert shrub-steppe, and semi-desert grasslands. Shadscale, fourwing saltbush, Mormon tea, Indian ricegrass, galleta, and blue and black gramas are typical. It is more arid, has lower elevations, and less pinyon-juniper than Ecoregion 22j to the south. Gently dipping Tertiary and Cretaceous sedimentary rocks are typical, although Jurassic and Triassic sandstones occur in the Arizona portion that includes Redrock Valley and some small mesas and valleys that drain to the San Juan River in New Mexico. The region is mostly Navajo tribal land. Land uses include some low-density livestock grazing of cattle, sheep, goats, and horses. In New Mexico, some irrigated agriculture occurs near the San Juan River, and oil and gas production is active in the northern part of the region. This ecoregion covers 61% of Eastern

Navajo, 41% of Shiprock, and 10% of Ft. Defiance agencies.

22j: Semiarid Tablelands (12% of the Navajo Nation)

The **Semiarid Tablelands** ecoregion consists of mesas, plateaus, valleys, and canyons formed mostly from flat to gently dipping sedimentary rocks, along with some areas of Tertiary and Quaternary volcanic fields. Bedrock exposures are common. Grass, shrubs, and woodlands cover the tablelands. Elevations in the Arizona portion range from about 5000 to just over 7500 feet. The vegetation is not as sparse as in Ecoregion 22i to the north or 22m to the east in New Mexico. It has more grassland and less sagebrush than Ecoregion 22q to the north and northwest. The ecoregion lacks the denser woodlands and forests of the higher-elevation, more mountainous Ecoregion 23. Scattered junipers occur on shallow, stony soils, and are dense in some areas. Pinyon-juniper woodland is also common, especially in New Mexico. Alkali sacaton, shadscale, fourwing saltbush, with inclusions of mixed gramas, ricegrass, and galleta also occur. This ecoregion covers 35% of Eastern Navajo, 23% of Ft. Defiance, and 2% of Western Navajo agencies.

22m: Albuquerque Basin (<1% of the Navajo Nation)

Part of one of the deeper physiographic basins of the Rio Grande rift, the **Albuquerque Basin** ecoregion is lower in elevation, drier, and warmer than surrounding ecoregions to the north, east, and west. The basin is filled with thick sediments of mostly Quaternary and some Tertiary age, with a few areas of volcanic rocks and lava-capped mesas. Extending from the La Bajada Escarpment on the north to near Socorro in the south, the region contains some diverse features and transitional characteristics. Unlike most of Ecoregion 22 which has mesic soils, 22m has a largely thermic soil temperature regime. There is a mix of sand scrub and desert grassland vegetation. Native vegetation includes black grama, sand dropseed, mesa dropseed, blue grama, galleta, sand sage, alkali sacaton, threeawns, and scattered yucca. Juniper occurs primarily in the north. Urban and suburban land uses are spreading. The Santa Fe Group aquifer, the drinking water source for Albuquerque and most of the Middle Rio Grande Valley, has seen some groundwater declines in recent years, along with increases in contaminants. This ecoregion covers <1% of Eastern Navajo.

22n: Near-Rockies Valleys and Mesas (<1% of the Navajo Nation)

Similar to Ecoregion 22h, the **Near-Rockies Valleys and Mesas** ecoregion is an area of mostly pinyon-juniper woodland, juniper savanna, and mesa and valley topography, with influences of

higher elevation vegetation in drainages from the adjacent Southern Rockies (21). Its geology differs from Ecoregion 22h, with older Tertiary and Cretaceous sedimentary rocks. It has generally higher elevations, greater precipitation, and more juniper than Ecoregion 22i to the west. Canyon streams flow intermittently out of the Rockies into the Canon Largo watershed, a tributary to the San Juan River. This ecoregion covers 2% of Eastern Navajo agency.

22o: Northeast Arizona Shrub-Grasslands (5% of the Navajo Nation)

The **Northeast Arizona Shrub-Grasslands** occur in the Little Colorado Basin at elevations mostly 4800 to 6200 feet. It has slightly more precipitation (7 to 12 inches), cooler temperatures, and more grassland than the lower elevation Ecoregion 22p. Vegetation here typically includes shadscale, fourwing saltbush, Mormon tea, blackbrush, Indian ricegrass, galleta, and blue and black gramas. This ecoregion covers 19% of Ft. Defiance and 2% of Western Navajo agencies.

22p: Little Colorado Valley/Painted Desert (5% of the Navajo Nation)

The Little Colorado Valley/Painted Desert ecoregion is lower, drier, and warmer than surrounding regions and has more desert scrub. Elevations are typically below 5000 feet, ranging from 4200 to 5700 feet. Precipitation is only 5 to 9 inches annually. Some sodic and saline soils occur or have gypsic horizons. A mix of shale badlands, greasewood flats, sand shrubland, and semi-desert grassland occurs in the region. Vegetation includes mound saltbush, fourwing saltbush, shadscale, Mormon tea, yucca, alkali sacaton, galleta, black grama, Indian ricegrass, and gyp dropseed. A long history of overgrazing has resulted in extensive rangeland deterioration. This ecoregion covers 17% of Western Navajo agencies.

22q: Dinétah Tablelands (15% of the Navajo Nation)

The **Dinétah Tablelands** ecoregion consists of plateaus, valleys, and deep canyons on Navajo and Hopi tribal land. The region is lower and warmer than the Mesa Highlands (22r). Cretaceous, Jurassic, and Triassic sedimentary rocks occur. Annual precipitation averages 8 to 13 inches and vegetation includes Utah juniper, pinyon pine, Wyoming big sagebrush, cliffrose, Mormon tea, fourwing saltbush, blackbrush, Indian ricegrass, needle and thread, western wheatgrass, galleta, black grama, blue grama, and sand dropseed. Land uses include livestock grazing, firewood and woodlot uses, subsistence hunting and gathering, and wildlife habitat. Coal mining occurs on Black Mesa. This ecoregion covers 38% of Chinle, 15% of Ft. Defiance, 12% of Western Navajo, and 2% of Shiprock agencies.

22r: Mesa Highlands (3% of the Navajo Nation)

The **Mesa Highlands** ecoregion includes the highest elevations of Balakai, Black, Skeleton, and Zinez mesas, ranging from 6800 to 8210 feet. The temperatures are cooler, and the annual precipitation is greater than in the lower-elevation Dinétah Tablelands (22q). Some ponderosa pine occurs here but is mostly lacking from the surrounding tablelands of Ecoregion 22q. Pinyon, juniper, big sagebrush, cliffrose, Mormon tea, muttongrass, prairie junegrass, squirreltail, western wheatgrass, and blue grama also occur. This ecoregion covers 10% of Chinle, 4% of Western Navajo, and <1% of Ft. Defiance agencies.

22s: Hopi Buttes (2% of the Navajo Nation)

The **Hopi Buttes** ecoregion is an area of volcanic geology in contrast to the surrounding sedimentary layers of adjacent ecoregions. The area of erosion-resistant remnants of volcanoes has elevations ranging from 5800 to 6828 feet. It is one of few volcanic fields in the world where a suite of maar crater deposits, tephra aprons, and underlying breccia-filled volcanic pipes are exposed. Vegetation includes Indian ricegrass, blue grama, galleta, winterfat, Stansbury cliffrose, Mormon tea, and widely spaced Utah juniper and pinyon. The region is contained within Navajo and Hopi tribal land, with livestock grazing and wildlife habitat as principal land uses. Uranium and other trace elements are part of the different geochemistry in this area, affecting springs and wells. Many water wells contain elevated levels of arsenic. This ecoregion covers 12% of Western Navajo and 10% of Shiprock agencies.

22t: Chinle Valley and Mesas (7% of the Navajo Nation)

The **Chinle Valley and Mesas** ecoregion is lower in elevation, warmer, with less precipitation and less woodland than adjacent Ecoregion 22q. It is higher in elevation, slightly cooler, with more grassland than the desert scrub of ecoregions 20d and 20h to the north. Elevations range from 5000 to 6400 feet, and annual precipitation is 7 to 10 inches. Typical vegetation includes Indian ricegrass, sand dropseed, galleta, needleandthread, fourwing saltbush, broom snakeweed, and Mormon tea. This ecoregion covers 35% of Chinle, 6% of Western Navajo, 5% of Shiprock, and 2% of Ft. Defiance agencies.

22u: Kaibito/Moenkopi Sandy Plateaus (11% of the Navajo Nation)

The **Kaibito/Moenkopi Sandy Plateaus** are distinguished by their abundance of eolian materials and sand shrubland vegetation communities. Sand and silt blown out of the Little Colorado River Valley is deposited on these plateau surfaces to the east. Elevations range from 4800 to 6300 feet and annual precipitation is 7 to 10 inches. Galleta grass, Indian ricegrass, spike dropseed, winterfat, and sand dropseed occur. Many areas that once supported grasslands are now dominated by snakeweed, soapweed yucca, and Mormon tea. This ecoregion covers 18% of Western Navajo, 2% of Ft. Defiance, and .04% of Chinle agencies.

22v: Marble Platform (2% of the Navajo Nation)

The **Marble Platform** ecoregion includes the limestone-capped plateau surface surrounding Marble Canyon as well as House Rock Valley to the west. Elevations range from about 3200 feet near Navajo Bridge in the north to just over 6500 feet on the summit of Shinumo Altar. Desert scrub is typical in the lower northern portions, with some desert grasslands in the higher elevations to the south and west. Livestock grazing has decreased from historical high levels, although cattle and bison herds still occur. Seeps and springs emerge from cliffs near the boundaries with adjacent ecoregions 20e and 23j and provide important water sources for wildlife. This ecoregion covers 7% of Western Navajo agencies.

22w: Grand Canyon (<1% of the Navajo Nation)

The scenic **Grand Canyon** is distinguished by its extreme relief, rough topography, and range of vegetation types. The exposed rocks from the canyon bottom to the top rims represent nearly 2 billion years of geologic history. Shales tend to erode to slopes, while harder sandstones and limestones form cliffs. At the canyon bottom, the older and harder metamorphic basement rocks produce a steep-walled, narrow, inner gorge. Elevations of the spectacular erosional landscape range from 2000 feet along the river in the west to 8000 feet at the North Rim. Strong aspect and elevation differences contribute to vegetation ranging from riparian to desert scrub to woodland. Along the river, willows, mesquite, catclaw acacia, and exotic tamarisk occur. Various desert scrub communities occur with species typical of Mojave, Sonoran, and Chihuahuan deserts. Upstream of the Little Colorado River, species more characteristic of Great Basin deserts predominate, such as big sagebrush, blackbrush, and rubber rabbitbrush. At higher elevations, pinyon-juniper woodland occurs with big sagebrush, snakeweed, Mormon tea, Utah agave, yuccas, winterfat, Indian ricegrass, dropseed, and needlegrass. Seeps and springs often contain rare plants. This ecoregion covers <1% of Western Navajo agency.

23c: Montane Conifer Forests (3% of the Navajo Nation)

The **Montane Conifer Forests** in Arizona are found at elevations from about 6000 to 9700 feet. Ponderosa pine and Gambel oak are common, along with mountain-mahogany, Arizona walnut, sycamore, serviceberry, and bitterbrush. Douglas-fir, Southwestern white pine, and white fir occur in a few areas, and blue spruce may be found in cool, moist canyons. Some influence of the Sierra Madre flora is seen

in the far southern mountains, especially in southwestern New Mexico, where a few Madrean oaks appear, such as silverleaf oak, netleaf oak, and Emory oak. The summer rains are especially important for herbaceous plants. Grasses include Arizona fescue, sheep fescue, mountain muhly, muttongrass, junegrass, and pine dropseed. Precipitation can range from 14 inches in the drier areas to as high as 39 inches on the Mogollon Rim or in the White Mountains. Air and soil temperatures are generally cooler than in the forests of Ecoregion 23l to the south. The region's plateaus, valleys, and deep canyons are geologically diverse with volcanic, sedimentary, and some intrusive and crystalline rocks. This ecoregion covers 10% of Chinle, 6% of Shiprock, 5% of Ft. Defiance, and .01% of Eastern Navajo agencies.

23e: Conifer Woodlands and Savannas (<1% of the Navajo Nation)

The **Conifer Woodlands and Savannas** ecoregion is an area of mostly pinyon-juniper woodlands, with some ponderosa pine at higher elevations. It often intermingles with grasslands and shrublands. Although elevations are higher than adjacent Ecoregion 22 areas, the boundaries tend to be transitional. The region is generally cooler, with more uniform winter and summer seasonal moisture compared to Ecoregion 23b. It lacks the milder winters, wetter summers, chaparral, Madrean oaks, and other species of Ecoregion 23b. Elevations are mostly 5000 to 8400 feet and precipitation averages 13 to 25 inches per year. Sedimentary substrates predominate with a few areas of volcanic rocks. Vegetation includes one-seed juniper, pinyon pine, Stansbury cliffrose, Apache plume, fourwing saltbush, Mormon tea, needle and thread, sideoats grama, blue grama, black grama, galleta, bottlebrush squirreltail, and muttongrass. It lacks the sagebrush of Ecoregion 23j to the north. This ecoregion covers 1% of Eastern Navajo agency.

23j: Northern Woodlands and Sagebrush (5% of the Navajo Nation)

The **Northern Woodlands and Sagebrush** ecoregion occurs at the lower elevations of the Kaibab Plateau and, to the east, surrounds the Defiance Plateau and the Chuska and Carrizo mountains. Juniper and pinyon pine dominate the woodland similar to Ecoregion 23e to the south; however, in this northern region, sagebrush is a more conspicuous component, and there is a less diverse grass and wildflower community. The climate also differs from Ecoregion 23e in that the majority of precipitation here occurs in the low-sun, cold season.

SPECIES SELECTION

The following is a table of common plant species on the Navajo Nation that can be used to restore native vegetation to your site (Table 2). Every restoration situation is different and will depend on site-specific characteristics such as temperature, precipitation, soil type, landform, land use, etc. We have assigned each plant species categories based on where they would be appropriate to be planted or seeded. The plant species category assignments are recommendations based on our observations and other regional resources and are not meant to be a definitive authority. It's important to spend time at your own site and observe the local vegetation and environmental factors. Use this list of species to compliment or add to the diversity of your site and help reach your restoration goals. We suggest choosing a combination of species to cover a range of growth seasons and bloom times.

CATEGORIES

STANDARD
Can't go wrong species. These species are generalists that grow to some extent in most places on the Navajo Nation. Depending on your restoration goals, create a mix with these grasses, wildflowers, and shrubs.

HIGH ELEVATION
These species commonly occur at higher elevation mesas and mountains of the Navajo Nation. If your homesite, rangeland, or restoration site is above approximately 7,000 ft in Pinon-juniper woodlands or Ponderosa forests, create a mix favoring these species.

WETLANDS
These species commonly grow in wetter habitats such as near springs, streams (riparian), or where groundwater is close to or at the surface.

SANDY SOILS
Species that can tolerate dry habitats with well drained sandy soils such as sand dunes. Even though these species do well in sand, they need moisture to germinate and grow. It is best to combine seeding or planting in these habitats with moisture retaining methods, such as mulch.

EROSION CONTROL
Species that grow in areas susceptible to wind or water erosion such as dry washes, slopes, or sandy soils. These species tend to grow fast, large, and spread once established.

POLLINATOR
Mainly wildflower species that have large or many, colorful flowers that attract pollinator species such as insects and birds. These species can be included in any mix to improve habitat for pollinators, for landscaping, or near gardens or agricultural fields to improve insect pollinated crop yield.

CLAY
These species are able to grow in clay soils. Clay soils tend to retain water and often have high alkalinity, preventing many species from growing. Include these species in your mix if your site has a high clay component and/or is alkaline (pH greater than 7).

ORNAMENTAL
Any native plant can be used for ornamental purposes around your home. However, these species are especially useful in landscaping because they are perennial, showy/unique flowered, large, attract wildlife, colorful, and/or retain aesthetics year-round. We recommend using these as alternatives to non-native ornamental plants.

Table 2. List of recommended native plant species for various categories of site characteristics and restoration goals.

SPECIES CATEGORIES ASSIGNMENT LIST			Standard	High Elevation	Wetlands	Sandy soils	Erosion control	Pollinator	Clay	Ornamental
COMMON NAME	**SCIENTIFIC NAME**	**TYPE**								
Alkali muhly	*Muhlenbergia asperifolia*	Warm season grass			•					
Alkali sacaton	*Sporobolus airoides*	Warm season grass	•							
Arizona fescue	*Festuca arizonica*	Cool season grass		•		•	•	•	•	•
Arizona three-awn	*Aristida arizonica*	Warm season grass		•						
Big sacaton	*Sporoblus wrightii*	Warm season grass			•		•			•
Black grama	*Bouteloua eriopoda*	Warm season grass	•			•	•			
Blue grama	*Bouteloua gracilis*	Warm season grass	•			•		•		•
Giant dropseed	*Sporobolus gigantea*	Warm season grass				•	•			
James' galleta	*Pleuraphis jamesii*	Warm season grass	•			•	•		•	
Little bluestem	*Schizachyrium scoparium*	Warm season grass		•						•
Mountain muhly	*Muhlenbergia montana*	Warm season grass		•						
Muttongrass	*Poa fendleriana*	Cool season grass	•	•			•			
Needle and thread grass	*Hesperostipa comata*	Cool season grass	•	•		•	•			
New Mexican feather grass	*Hesperostipa neomexicana*	Cool season grass	•			•	•			•
Pine dropseed	*Blepharoneuron tricholepis*	Warm season grass		•						
Prairie junegrass	*Koeleria macrantha*	Cool season grass		•						
Purple three-awn	*Aristida purpurea*	Warm season grass	•							
Ricegrass	*Achnatherum hymenoides*	Cool season grass	•			•	•			•
Saltgrass	*Distichlis spicata*	Warm season grass			•					
Sand dropseed	*Sporobolus cryptandrus*	Warm season grass	•			•	•			
Sideoats grama	*Bouteloua curtipendula*	Warm season grass	•				•			
Slender wheatgrass	*Elymus trachycaulus*	Cool season grass	•	•			•			
Spike dropseed	*Sporobolus contractus*	Warm season grass	•			•	•			
Squirreltail	*Elymus elymoides*	Cool season grass		•						
Vine mesquite	*Hopia obtusa*	Warm season grass			•					
Beebalm	*Monarda fistulosa*	Wildflower			•			•		
Blanket flower	*Gaillardia pinnatifida*	Wildflower				•		•		
Cowpen daisy	*Verbesina enceliodes*	Wildflower				•		•		
Desert 4-o'clock	*Mirabilis multiflora*	Wildflower				•		•		•
Globemallow	*Sphaeralcea spp.*	Wildflower	•				•	•	•	
Milkweed	*Asclepias spp.*	Wildflower						•		•
Navajo tea	*Thelesperma megapotamicum*	Wildflower	•			•		•	•	
Penstemon	*Penstemon spp.*	Wildflower						•		•
Pale evening primrose	*Oenothera pallida*	Wildflower	•			•	•	•	•	
Redroot buckwheat	*Eriogonum racemosum*	Wildflower	•	•				•		
Rocky Mtn. bee plant	*Cleome serrulata*	Wildflower	•			•		•		
Hoary tansy aster	*Machaeranthera canescens*	Wildflower	•			•		•		
Threadleaf groundsel	*Senecio flaccidus*	Wildflower				•		•		
Western yarrow	*Achillea millefolium*	Wildflower		•	•			•		•
White prairie clover	*Dalea candida*	Wildflower	•			•	•	•		

SPECIES CATEGORY ASSIGNMENT LIST

COMMON NAME	SCIENTIFIC NAME	TYPE	Standard	High Elevation	Wetlands	Sandy soils	Erosion control	Pollinator	Clay	Ornamental
Antelope bitterbrush	*Purshia tridendata, P. stansburyiana*	Shrub					•	•		•
Apache plume	*Fallugia paradoxa*	Shrub						•		•
Big sagebrush	*Artemisia tridentata*	Shrub	•							•
Chokecherry	*Prunus virginiana*	Shrub		•				•		•
Coyote willow	*Salix exigua*	Shrub			•		•			
Four-wing saltbush	*Atriplex canescens*	Shrub					•		•	
Greasewood	*Sarcobatus vermiculatus*	Shrub					•		•	
Mountain mahogany	*Cercocarpus montanus*	Shrub		•				•		•
Rubber rabbitbrush	*Ericameria nauseosa*	Shrub	•			•	•	•		•
Sumac	*Rhus aromatica, R. trilobata*	Shrub	•			•	•			•
Utah Serviceberry	*Amelanchier utahensis*	Shrub		•				•		•
Wax currant	*Ribes cereum*	Shrub		•				•		•
Winterfat	*Krascheninnikovia lanata*	Shrub					•			•
Wood's rose	*Rosa woodsia*	Shrub		•	•			•		•
Yucca	*Yucca baileyi, Y. baccata*	Shrub				•		•		•
Fremont cottonwood	*Populus fremontii*	Tree			•					•
Gambel's Oak	*Quercus gambelii*	Tree		•						•
Goodding's willow	*Salix gooddingii*	Tree			•					•
Juniper	*Juniperus monosperma, J. osteosperma, J. scopulorum*	Tree				•				•

SPECIES DESCRIPTIONS

COMMON NAME
This list is organized alphabetically by common name within each functional group (grass, wildflower, shrub, tree).

BOTANICAL NAME
This is the technical name used by botanist and taxonomist. Also known as the scientific or Latin name and consist of the Genus and species.

DINÉ NAME
The Navajo names of plants were taken from the book “Nanise’ A Navajo Herbal” by Mayes and Lacy, and the online resource “Selected Plants of Navajo Rangelands” by New Mexico State University.

FORM
General growth characteristics of each species, including growth season (warm vs. cool season), life habit (perennial vs. annual), and functional group (grass, wildflower, shrub, tree). Warm season plants typically grow in the summer, where cool season plants can grow in the spring and fall.

FLOWERING TIME
The months that the species’ flower is in bloom (seeding will happen shortly after this time).

ELEVATION
Range of elevations the species occurs.

USES
Categories/situations we determined each species would be appropriate to plant or seed.

SUGGESTED SEEDING RATE
Poundage of Pure Live Seed recommended per acre (lbs. PLS/acre). The rates and suggested planting methods were primarily taken from USDA NRCS Fact Sheets/Plant Guides that can be found on the USDA PLANTS Database. (www.plants.usda.gov).

SUGGESTED PLANTING METHOD
Suggestions on timing, depth, and method of planting seeds.

SHORT DESCRIPTION
Descriptions of plants based on staff personal experience and several botanical resources including USDA Plants Database, SEINet (www.swbiodiversity.org), and Flora of the Four Corners Region (Heil et al. 2013).

LIST OF PLANT SPECIES FOR RESTORATION

GRASSES

WILDFLOWERS

SHRUBS

TREES

Alkali Muhly

Photo Credit: Max Licher, SEINet Portal Network

BOTANICAL NAME
Muhlenbergia asperifolia

DINÉ NAME
Unknown

FORM Warm season perennial grass

ELEVATION
4,000 - 6,500 ft.

BLOOM TIME
June - September

USES
Wetlands

SUGGESTED SEEDING RATE
0.05 - 0.75 lbs. PLS (pure live seed)/acre

SUGGESTED PLANTING METHOD
Broadcast seed in early Spring at ¼ inch depth.

SHORT DESCRIPTION
Rhizomatus (spreading by the roots), perennial grass 10 - 60 cm tall. Inflorescences are open panicles that seem to "float" above its vegetation. Alkali muhly is a great choice for streambanks, sandy washes, alkali seeps, and wet meadows. Tolerates salty soils and shade. It is a good choice for erosion control in these areas as well because of its rhizomatous growing habit, as long as it has ready access to moisture. Its alternative common name is "scratchgrass" because of its scratchy sharp leaf blade edges.

Alkali Sacaton

Photo Credit: Sherel Goodrich, SEINet Portal Network

BOTANICAL NAME
Sporobolus airoides

DINÉ NAME
Tł'ohdá'ákáłiitsoh

FORM
Warm season perennial bunchgrass

ELEVATION
2,500 - 6,500 ft.

BLOOM TIME
May - October

USES Standard, sandy soils, erosion control, pollinator, clay, ornamental

SUGGESTED SEEDING RATE
0.25 - 0.5 lbs. PLS/acre

Photo Credit: Patrick Alexander, SEINet Portal Network

SUGGESTED PLANTING METHOD
Broadcast seed in Spring or directly sow into containers. No seed treatment needed.

SHORT DESCRIPTION
Large, common perennial grass occurring at most elevations of the Navajo Nation on sandy plateaus, washes, flats, and bottomlands. Tolerates salty alkaline soils. Inflorescences are open spreading panicles with single-seeded spikelets. Great all-purpose choice for improving native plant cover, increasing forage, or restoring alkali sites; especially within low-elevation areas of the Nation, and where soils are sandy.

Photo Credit: Max Licher, SEINet Portal Network

Arizona Fescue

BOTANICAL NAME
Festuca arizonica

DINÉ NAME
Tsinyaatł'ohyilzólí

FORM
Cool season perennial bunchgrass

ELEVATION
6,000 - 10,000 ft.

BLOOM TIME
June - August

USES
High elevation

SUGGESTED SEEDING RATE
4 - 5 lbs. PLS/acre in critical planting areas.

SUGGESTED PLANTING METHOD
Broadcast or drill seed in fall to coincide with monsoonal moisture. Sow at a depth of ¼ to ½ inches.

SHORT DESCRIPTION
High elevation bunchgrass found in understories of ponderosa pine, pinyon-juniper, fir-spruce, and Western hardwood forests, and high meadows. Moderately palatable to domestic livestock but provides good forage for deer, elk, and antelope and good habitat for native small mammals and birds. Recommended for high elevation areas of the Navajo Nation receiving at least 10 inches of annual rainfall. Does well in shady sites and on clay and loam soils, not tolerant of heavy grazing.

Photo Credit: Max Licher, SEINet Portal Network

Photo Credit: Russ Kleinman, SEINet Portal Network

Arizona Three-awn

BOTANICAL NAME
Aristida arizonica

DINÉ NAME
Azéé'iilwo'iiyázhí,
general name for Aristida spp.

FORM
Warm season perennial grass

ELEVATION
4,000 - 8,000 ft.

BLOOM TIME
July - October

USES
High elevation

SUGGESTED SEEDING RATE
4 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Broadcast seed in late summer or fall.

SHORT DESCRIPTION
This grass is found at higher elevations, in pine-oak or pinon-juniper woodlands. It's bigger than its cousin, the purple three-awn, with similarly low palatability for livestock. It can grow by rhizomes (above-ground roots), which makes it a good candidate for erosion-control.

Big Sacaton

Photo Credit: Sue Carnahan, SEINet Portal Network

BOTANICAL NAME
Sporobolus wrightii

DINÉ NAME
Unknown

FORM
Warm season perennial bunchgrass

BLOOM TIME
August - October

ELEVATION
2,000 - 6,500 ft.

USES
Wetlands, erosion control, ornamental

SUGGESTED SEEDING RATE
Unknown

SUGGESTED PLANTING METHOD
Plugs/container recommended or broadcast at ⅛ - ¼ inch deep in fall or early spring. No seed treatment needed.

SHORT DESCRIPTION
Robust attractive perennial bunchgrass, up to 6 ft tall and 3 ft in diameter with open spreading panicles. Occurring in semi-desert grassland and shrubland communities in association with blue grama, galleta grass, sand dropseed, and/or New Mexico feathergrass in places where it can access groundwater. Also occurs in wet places such as riverbanks, sandy washes, and floodplains. While once common across the Southwest, big sacaton has largely disappeared from valley bottoms and riparian areas due to overgrazing, agriculture, and water diversion, and are now present in only 5% of its historic range. Not a very common plant of the Navajo Nation, though it is sometimes seeded roadside. It's large size and quick growth make it a good choice for windbreaks and an easy low-water ornamental option.

Photo Credit: Sue Carnahan, SEINet Portal Network

Photo Credit: Max Licher, SEINet Portal Network

Black Grama

BOTANICAL NAME
Bouteloua eriopoda

DINÉ NAME
Tł'ohnást'ąsłizhiní

FORM
Warm season perennial grass

BLOOM TIME
July - October

ELEVATION
3,000 - 5,000 ft.

USES
Standard, sandy soils, erosion control

SUGGESTED SEEDING RATE
0.5 - 1 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Broadcast seed in July-early August. In our experience, germination rate is highly variable. No seed treatment needed.

SHORT DESCRIPTION
A drought-tolerant, perennial grass, spreading vegetatively through stolons, preferring rocky or sandy mesas and flats and sandy or gravelly soils. In Leupp, occurring in loamy soils with volcanic cinder gravel overlay or sandy soils. Typically associated with blue grama, spike dropseed, and James' galleta grass. Black grama was historically much more common across the SW, but it is highly palatable and has disappeared from across the Navajo Nation due to overgrazing. Where there are large stands of black grama remaining (Leupp, Gray Mountain, parts of Marble Canyon), it is the dominant species. Black grama is prized by ranchers for its excellent forage, especially as a winter food source for cattle. However, it is not very tolerant of moderate or heavy grazing because of its stoloniferous method of reproduction, which is susceptible to trampling. Summer grazing does more damage to stands than spring, winter, and fall grazing. Black grama stands can be maintained with seasonal rotation of livestock and ensuring that livestock are not allowed to remain in one area long enough to remove more than 30% of total annual production.

Photo Credit: Patrick Alexander, SEINet Portal Network

Blue Grama

Photo Credit: Max Licher, SEINet Portal Network

BOTANICAL NAME	DINÉ NAME
Bouteloua gracilis	Tł'ohnást'ąsi

FORM	BLOOM TIME
Warm season perennial grass	July - October
ELEVATION	**USES**
4,000 - 8,000 ft.	Standard, sandy soils, pollinator, ornamental

SUGGESTED SEEDING RATE
1 - 3 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Broadcast seed from June 15th – July 15th. No seed treatment necessary.

SHORT DESCRIPTION
Extremely common rangeland grass of most elevations of the Navajo Nation (both high and low), and tolerant of drought and salinity. Does not do well in dense shade, in wet places, or floodplains. Mature seed heads are curved and look like eyebrows. Habitat can be tufted (mounding) to sod-like, especially when overgrazed. Leaves are green-blue during the growing season, and curly and straw-colored when dry. Blue grama is fairly tolerant of grazing and provides good forage for livestock and wildlife, once established. This is a great choice for inclusion in an all-purpose rangeland restoration mix in most places across the Navajo Nation.

Giant Dropseed

BOTANICAL NAME	DINÉ NAME
Sporobolus giganteus	Tł'ohyilzólítsoh

FORM	BLOOM TIME
Warm season perennial bunchgrass	July - October
ELEVATION	**USES**
Below 6,000 ft.	Sandy soils, erosion control

SUGGESTED SEEDING RATE
2 - 3 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Broadcast seed in late summer.

SHORT DESCRIPTION
Large (3 - 6 ft) drought-tolerant perennial grass with spike-like flowers preferring sand dunes and sandy soils along rivers and roadsides. Good choice for stabilizing deep sandy soils. Poor to fair palatability for livestock.

James' Galleta

BOTANICAL NAME	DINÉ NAME
Pleuraphis jamesii	Tł'ohdich'ízhí, Tł'oh łíchí'í

FORM	BLOOM TIME
Warm season perennial grass	May - October
ELEVATION	**USES**
3,500 - 7,500 ft.	Standard, sandy soils, erosion control, clay

SUGGESTED SEEDING RATE

2 - 6 lbs. PLS/acre, 4 - 12 lbs. PLS/acre for highly eroded areas.

SUGGESTED PLANTING METHOD

This species does not germinate well from seed collected from the wild, recommend planting plugs (container grown plants). Or, if seeding, we recommend purchasing a native cultivar such as 'Viva' and seeding in early spring or late summer.

SHORT DESCRIPTION

This is a very common rhizomatus grass on the Navajo Nation, found at all elevations. One of the few grasses that tolerates fine-textured and clay soils well. Last year's flowering spikes have a distinct zig-zag pattern once all the seeds have dispersed. Good forage for cattle, horses, and livestock and handles trampling and foot traffic well. Also used to some extent as forage by antelope, deer, and bighorn sheep.

Little Bluestem

Photo Credit: Max Licher SEINet Portal Network

BOTANICAL NAME	DINÉ NAME
Schizachyrium scoparium	Tł'ohdeiłichi'í
FORM	**BLOOM TIME**
Warm season perennial bunchgrass	July - October
ELEVATION	**USES**
5,000 - 8,000 ft.	High elevation, ornamental

SUGGESTED SEEDING RATE

7 - 10 lbs. PLS/per acre for pasture planting

SUGGESTED PLANTING METHOD

Seed in early spring or plant containers (plugs) for landscaping purposes. Many of the cultivars are developed for the Midwestern region of the United States, for our region the cultivar 'Pastura' is recommended.

SHORT DESCRIPTION

Common attractive perennial grass found in higher elevations of the Navajo Nation in oak and juniper woodlands, ponderosa pine understory, and mountain grasslands and meadows. Plants are deep rooted, moderately drought tolerant, and slow to establish from seed. Provides great nesting and roosting habitat for a variety of small mammals and bird species and seeds are used as a winter food source for birds. Provides fair to good forage for cattle and horses. Stems turn an attractive red color in fall/winter which makes little bluestem a great choice as a low water ornamental grass for landscaping.

Photo Credit: Patrick Alexander, SEINet Portal Network

Photo Credit: Max Licher, SEINet Portal Network

Mountain Muhly

BOTANICAL NAME
Muhlenbergia montana

DINÉ NAME
Bé'ézhóó'

FORM
Warm season perennial bunchgrass

ELEVATION
7,350 - 9,100 ft.

BLOOM TIME
July - September

USES
High elevation

SUGGESTED SEEDING RATE
1 - 2 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Seed awns make this species difficult to broadcast, we recommend planting plugs. No seed treatment necessary.

SHORT DESCRIPTION
Mountain muhly, as the name implies, is a common bunch grass that grows at higher elevations on dry rocky slopes and ridgelines in ponderosa pine forest openings. It can be distinguished by its open panicle and single florets with twisting awns (6 - 25 mm long). It is considered high forage value for livestock although, in general, is dispersed in its habitat and doesn't form dense communities.

Photo Credit: Max Licher, SEINet Portal Network

Photo Credit: Patrick Alexander, SEINet Portal Network

Mutton Grass

BOTANICAL NAME
Poa fendleriana

DINÉ NAME
Tł'ohnikání

FORM
Cool season, perennial bunchgrass

ELEVATION
4,500 - 12,200 ft.

BLOOM TIME
May - September

USES
Standard, high elevation, erosion control

SUGGESTED SEEDING RATE
2 - 3 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Broadcast or drill seed in late fall at a depth of ¼ inch.

SHORT DESCRIPTION
Muttongrass is a perennial bunchgrass that grows in open pinyon-juniper woodlands and ponderosa forests in well drained, gravelly or sandy soils. It is considered excellent forage for livestock and wildlife. Its deep fibrous root system and drought tolerance make it useful for soil stabilization and restoration

Photo Credit: Max Licher, SEINet Portal Network

Needle and Thread Grass

Photo Credit: Tony Frates, SEINet Portal Network

BOTANICAL NAME
Hesperostipa comata

DINÉ NAME
Ch'il Bilata dee'ni'ni'

FORM
Cool season, perennial bunchgrass

ELEVATION
5,000 - 8,200 ft.

BLOOM TIME
May - July

USES Standard, high elevation, sandy soils, erosion control

SUGGESTED SEEDING RATE
6 - 14 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Broadcast or drill in late fall or spring at a depth of ¾ - ½ inch. No cold stratification or 120 days cold stratification readily germinate seed (short cold stratification treatments <60 days can reduce germination).

SHORT DESCRIPTION
Needle and thread grass is a distinct, cool season, bunchgrass that greens-up and seeds in the spring. It can be identified by its tall (up to 4 ft) seed heads, with long twisted awns that resemble a needle and thread. It grows in a variety of habitats including low elevation sandy plant communities and higher elevation ponderosa pine forests. It is useful for erosion control and reclamation in sandy sites and is considered good forage for livestock and wildlife while not in seed.

New Mexican Feather Grass

Photo Credit: Max Licher, SEINet Portal Network

BOTANICAL NAME
Hesperostipa neomexicana

DINÉ NAME
Tł'ohdit'ódítsoh

FORM Cool season, perennial bunchgrass

ELEVATION
5,800 - 6,400 ft.

BLOOM TIME
May - June

USES
Standard, sandy soils, erosion control, ornamental

Photo Credit: Max Licher, SEINet Portal Network

SUGGESTED SEEDING RATE
10 - 16 lbs. PLS/acre

SUGGESTED PLANTING METHOD
See needle and thread grass (*Hesperostipa comata*).

SHORT DESCRIPTION
Appearance very similar to *Hesperostipa comata*, but seed awn has fine hairs resembling a feather. It grows in well drained, sandy-rocky soils in grasslands, mesas, and canyons.

Photo Credit: Max Licher, SEINet Portal Network

Pine Dropseed

BOTANICAL NAME
Blepharoneuron tricholepis

DINÉ NAME
Tł'ohyilzólí

FORM
Warm season, perennial bunchgrass

BLOOM TIME
July - October

ELEVATION
7,000 - 12,000 ft.

USES
High elevation

SUGGESTED SEEDING RATE
Unknown

Photo Credit: Patrick Alexander, SEINet Portal Network

SUGGESTED PLANTING METHOD
Unknown

SHORT DESCRIPTION
Pine dropseed is generally found at higher elevations on the Navajo Nation in dry, rocky to sandy soils in open ponderosa pine-oak forests. It is distinguished by its open, grayish panicle and is considered good livestock forage in high elevation forests.

Photo Credit: Liz Makings, SEINet Portal Network

Prairie Junegrass

BOTANICAL NAME
Koeleria macrantha

DINÉ NAME
Tł'ooléts'ózí

FORM
Cool season, perennial bunchgrass

BLOOM TIME
June - August

ELEVATION
7,000 - 9,500 ft.

USES
High elevation

SUGGESTED SEEDING RATE
1 - 2 lbs. PLS/acre

Photo Credit: Kristin Phillips, SEINet Portal Network

SUGGESTED PLANTING METHOD
Broadcast seed should be planted at the soil surface to ⅛ inch depth, seed requires light to achieve maximum germination.

SHORT DESCRIPTION
Prairie junegrass is a perennial bunchgrass that most commonly grows on well-drained soils in pinyon and ponderosa pine forest openings. It is considered good livestock and wildlife forage, although palatability declines as seeds form. It is useful for reclamation and erosion control and does best when seeded in the spring. The exclusion of grazing animals until plants become well established is recommended. This may require up to 2 - 3 growing seasons.

Purple Three-awn

Photo Credit: Tony Frates, SEINet Portal

BOTANICAL NAME
Aristida purpurea

DINÉ NAME
Azéé'iilwo'iiyázhí,
general name for Aristida spp.

FORM
Warm season perennial grass

BLOOM TIME
April - October

ELEVATION
1,000 - 7,000 ft.

USES
Standard

SUGGESTED SEEDING RATE
4 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Broadcast seed in late summer or fall

SHORT DESCRIPTION
This is a relatively short (6 - 30 inches), drought-tolerant wide-spread native grass that grows in dry, coarse, or sandy soils. It has a purple color to it when fully mature and the flower has three long awns. It is decent forage while it is green, but the long awns can get caught in animal skin and fur, causing abscesses. It is generally less-palatable to livestock compared with other native grasses, so tends to increase in highly-grazed areas. It seeds readily and is a great choice for highly degraded areas.

Ricegrass

Photo Credit: Patrick Alexander, SEINet Portal Network

BOTANICAL NAME
Achnatherum hymenoides

DINÉ NAME
Ndídlídii

FORM
Cool Season perennial bunchgrass

BLOOM TIME
May - August

ELEVATION
4,000 - 8,200 ft.

USES Standard, sandy soils, erosion control, ornamental

SUGGESTED SEEDING RATE
6 - 12 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Ricegrass seeds collected from wild populations are notoriously difficult to germinate. Scarify seeds lightly with sandpaper and sow in the fall or place in cold/moist stratification for 6 - 10 months if growing plugs. Direct sow seeds should be planted deep, ½ - 3 inch, to aid in the stratification process and make the seed less likely to be dug up by rodents. Germination may be better in the second year. Use of older seed up to 4 to 6 years of age may improve germination.

SHORT DESCRIPTION
Indian ricegrass is a very drought-tolerant, cool season grass that commonly grows in sandy soils, on sand dunes and dry washes; although it can also be found in desert scrub, pinon-juniper, and pine woodlands. It stands 30 - 70 cm tall with leaves wiry (round) in appearance. The seed heads are an open panicle with round dark-brown seeds. The seeds and leaves are highly palatable to livestock and wildlife.

Photo Credit: Max Licher, SEINet Portal Network

Saltgrass

BOTANICAL NAME
Distichlis spicata

DINÉ NAME
Tł'ohdík'ózhíǫtł'oolédich'ízhí

FORM
Warm season, perennial, mat forming grass

BLOOM TIME
May - September

ELEVATION
4,500 - 6,500 ft.

USES
Wetlands

SUGGESTED SEEDING RATE
Unknown

SUGGESTED PLANTING METHOD
Seeds or by rhizome cuttings. Seeds need consistently moist soil and high temperatures to germinate. It is easier to propagate saltgrass using rhizome cuttings. Keep cuttings moist and store between 35 - 50^{o} F until ready to plant. Plant rhizomes at a depth of 1 - 2 inches.

SHORT DESCRIPTION
Saltgrass is a common, perennial grass that forms dense mats in low lying, moist, salty soils. It is useful for erosion control in moist, salty soils due to its rhizomatous (spreading by roots)/stoloniferous growth habit. It is considered fair to good forage value for livestock and is important pollinator/wildlife habitat. Several traditional medicinal uses including use as a food seasoning.

Photo Credit: Max Licher, SEINet Portal Network

Sand Dropseed

BOTANICAL NAME
Sporobolus cryptandrus

DINÉ NAME
Tł'ohtsohzhóó'

FORM
Warm season perennial grass

BLOOM TIME
May - September

ELEVATION
Below 7,000 ft.

USES
Standard, sandy soils, erosion control

SUGGESTED SEEDING RATE
0.5 - 1 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Broadcast seed in late fall or early spring (needs to overwinter outside). Do not bury more than ⅛ inch.

SHORT DESCRIPTION
A widespread drought-tolerant perennial native bunchgrass that is found across the Navajo Nation in sandy, coarse, and gravelly soils. It grows as tall as 2 - 3 ft and is fairly good livestock forage. It is a great plant for erosion-control as its roots can spread 2 feet across and very deep. After seeding, do not graze the area for 2 years to allow plants to establish. Can withstand heavy grazing but can be killed with continual (many years) overuse.

Photo Credit: Sue Carnahan, SEINet Portal Network

Sideoats Grama

Photo Credit: Patrick Alexander, SEINet Portal Network

BOTANICAL NAME	DINÉ NAME
Bouteloua curtipendula	Tł'ohłichi'í

FORM	BLOOM TIME
Warm season perennial grass	June - November
ELEVATION	**USES**
2,500 - 7,000 ft.	Standard, erosion control

SUGGESTED SEEDING RATE
2.5 - 5 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Drill seeding or broadcast, bury ¼ - ¾ inch.

SHORT DESCRIPTION
This is a medium-sized bunchgrass at least 15 - 30 inches tall with distinct flowering spikes that rise out of the base adorned with many flag-like seed heads along one side (hence the name, sideoats grama). It prefers slightly sodic or alkaline soils. It is a good forage plant as it stays greener longer than many range grasses. However, it isn't as resistant to grazing as other grama grasses, which is likely why it currently isn't as commonly seen on the Navajo Nation. It would need some protection from overgrazing once seeded to remain for the long-term.

Slender Wheatgrass

Photo Credit: Max Licher, SEINet Portal Network

BOTANICAL NAME	*DINÉ NAME*
Elymus trachycaulus	Tł'ooléyilts'oozí

FORM	BLOOM TIME
Cool season, perennial bunchgrass	June - September
ELEVATION	**USES**
5,300 - 12,600 ft.	Standard, high elevation, erosion control

SUGGESTED SEEDING RATE
3 - 10 lbs. PLS/acre, lower to 1 - 2 lbs. PLS/acre if using in a seed mix.

Photo Credit: Max Licher, SEINet Portal Network

SUGGESTED PLANTING METHOD
Broadcast or drill seed to a depth of ¼ - ¾ inches.

SHORT DESCRIPTION
Slender wheatgrass is a variable, short-lived, bunch grass that grows in a range of plant communities from sage brush to spruce-fir forests. It is considered excellent to good forage for livestock and wildlife. It is useful for reclamation and erosion control due its quick germination, good seedling vigor, and moderate drought tolerance. Because it is a short-lived perennial, it is best suited as a filler component in seed mixtures containing slower-established, long-lived perennial species.

Photo Credit: Max Licher, SEINet Portal Network

Spike Dropseed

BOTANICAL NAME
Sporobolus contractus

DINÉ NAME
Tł'ohyilzólídeeníní

FORM
Warm season perennial grass

ELEVATION
2,500 - 6,500 ft.

BLOOM TIME
August - October

USES
Standard, sandy soils, erosion control

SUGGESTED SEEDING RATE
1 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Drill or broadcast seed and bury ⅛ inch in fine soils and up to ½ inch in sandy soils.

SHORT DESCRIPTION
This is a large (up to 3 ft tall) perennial bunchgrass found in fine-textured (high amount of silt or clay) and sandy soils. It has a dense, contracted flower spike. Spike dropseed can grow in thick mats near the soil surface and is relatively resistant to heavy grazing. To keep a healthy stand, never graze it shorter than 5 - 6 inches and let it occasionally re-seed.

Photo Credit: Patrick Alexander, SEINet Portal Network

Photo Credit: Max Licher, SEINet Portal Network

Squirreltail

BOTANICAL NAME
Elymus elymoides

DINÉ NAME
Azéé'iilwo'iindtsaaí

FORM
Cool season perennial grass

ELEVATION
2,000 - 11,500 ft.

BLOOM TIME
March - August

USES
High elevation

SUGGESTED SEEDING RATE
7 lbs. PLS/acre for pure stands

SUGGESTED PLANTING METHOD
Broadcast or drill seed in late fall at a depth of ¼ - ½ inch.

SHORT DESCRIPTION
Drought-resistant bunchgrass (8 - 24 inch) that begins growing in early spring and can remain green through the fall. The seed heads are fine and needle-like with awns up to 4 inches long. Squirreltail is decent forage early in the year, especially for sheep, but the large, dried awns can harm animal's mouths, ears, and digestive tracts.

Photo Credit: Patrick Alexander, SEINet Portal Network

Vine Mesquite

Photo Credit: Max Licher, SEINet Portal Network

BOTANICAL NAME
Hopia obtusa

DINÉ NAME
Unknown

FORM
Warm season perennial grass

ELEVATION
1,000 - 6,000 ft.

BLOOM TIME
May - October

USES
Wetlands

SUGGESTED SEEDING RATE
6 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Broadcast or drill in spring. Can also be grown in containers and transplanted.

SHORT DESCRIPTION
Vine mesquite is 12 - 24 inches tall with small nut-like seeds. This is a sod-forming and rhizomatous perennial grass that prefers wetter soils, silts, and clays. It tends to grow in pure (single species) dense stands. It has excellent erosion control on stream and spring edges, playas, gullies, roadsides, and arroyos. It is desirable forage for livestock and diverse wildlife, including big game, birds, and small mammals. It establishes slowly, does not like to be overgrazed, but does increase its growth after fire.

Western Wheatgrass

Photo Credit: Max Licher, SEINet Portal Network

BOTANICAL NAME
Pascopyrum smithii

DINÉ NAME
Tł'oolé, Tł'oh nitł'izí

FORM
Warm season perennial grass

ELEVATION
3,000 - 8,000 ft.

BLOOM TIME
June - August

USES
Standard, high elevation, erosion control

SUGGESTED SEEDING RATE
8 lbs. PLS/acre

Photo Credit: Kristin Phillips, SEINet Portal

SUGGESTED PLANTING METHOD
Drill or broadcast seed in late fall or early spring. Also does well by transplanting.

SHORT DESCRIPTION
This is a rhizomatous blue-green grass that often grows in pure (single species) large stands and has strong deep roots. For this reason, it is an excellent choice for erosion control and ground cover. However, it can out-compete native species, so it is not a great choice for projects where diversity is a goal. It provides excellent forage for livestock and wildlife, and it can withstand heavy grazing. The seed spike is compressed, stiff, and 2 - 6 inches long. It has a large distribution across the high plains and western U.S. It can handle salty soils and does best in fine-textured soils. It is drought tolerant but can also handle periodic flooding.

Photo Credit: Max Licher, SEINet Portal Network

Beebalm

BOTANICAL NAME
Monarda fistulosa

DINÉ NAME
Kétłoh, general name for Monarda spp.

FORM
Perennial wildflower

BLOOM TIME
July - September

ELEVATION
5,000 - 8,500 ft.

USES
Wetlands, pollinator

SUGGESTED SEEDING RATE
Unknown

SUGGESTED PLANTING METHOD
Broadcast seed in late fall or early spring. One month cold stratification recommended if planting in containers.

SHORT DESCRIPTION
Beebalm is in the mint family with aromatic leaves, like oregano, and grows 11 - 30 inches tall. The showy flower is a lavender-purple pom-pom with many tubular flowers arranged on a dome. It grows with creeping rhizomes and is often found in clumps. It prefers moist soils and sun to partial shade. It is a culinary and medicinal plant with many uses, and loved by butterflies, bees, hummingbirds, and pollinating moths.

Photo Credit: Max Licher, SEINet Portal Network

Photo Credit: Max Licher, SEINet Portal Network

Blanket Flower

BOTANICAL NAME
Gaillardia pinnatifida

DINÉ NAME
Ch'ilbílátahózhóón, general name for Gaillardia spp.

FORM
Perennial wildflower

BLOOM TIME
May - August

ELEVATION
4,000 - 7,000 ft.

USES
Standard, pollinator, ornamental

SUGGESTED SEEDING RATE
4 - 5 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Late fall to early spring; do not plant deeper than ¼ inch.

SHORT DESCRIPTION
Blanket flower is a showy yellow and red daisy-like flower. It can grow up to 2 ft tall and has narrow green leaves. It is drought tolerant and commonly seeded; often seen in open areas and along roadsides. It is a prolific seeder whose scaled seeds fall off, leaving a naked ball that is sometimes mis-identified as the seed head. There are several other blanket flower species, such as *G. pulchella*, that occupy similar habitat.

Photo Credit: Patrick Alexander, SEINet Portal Network

Cowpen Daisy

BOTANICAL NAME
Verbesina encelioides

DINÉ NAME
Nidíyílii łibáhígíí

FORM
Annual wildflower

BLOOM TIME
April - September

ELEVATION
3,000 - 8,000 ft.

USES
Standard, pollinator

SUGGESTED SEEDING RATE
Unknown

SUGGESTED PLANTING METHOD
Direct sow in the fall.

SHORT DESCRIPTION
This is an annual bright yellow wildflower related to sunflowers. It is weedy and often seen growing in pure (single species) stands, covering large amounts of land in the summertime. The leaves are blue-green in color with a narrowed or tapered base. It's most distinctive characteristic besides its color is the unique pungent smell of the leaves. It is a great pollinator plant. It grows well in disturbed sites and places where water pools (e.g., roadsides, drainage ditches). Can be weedy.

Desert 4 O'clock

Photo Credit: Max Licher, SEINet Portal Network

BOTANICAL NAME
Mirabilis multiflora

DINÉ NAME
Tsédédéèh

FORM
Perennial wildflower

BLOOM TIME
May - August

ELEVATION
500 - 8,500 ft.

USES
Sandy soils, pollinator, ornamental

SUGGESTED SEEDING RATE
Unknown

Photo Credit: Max Licher, SEINet Portal Network

SUGGESTED PLANTING METHOD
Broadcast seed in the Fall. Scarify seeds with sandpaper, if growing in containers.

SHORT DESCRIPTION
This low-growing sub-shrub grows 1 - 2 ft tall and up to 5 ft wide. It has distinctive fleshy heart-shaped leaves and showy magenta-purple tubular flowers that grow in clusters. It is often found growing beneath juniper trees, is highly drought tolerant, and prefers dry rocky, sandy or loamy soils (does not like clay soils). It is pollinated by butterflies and hummingbirds but loved by hawk moths foraging at dusk. It has a large root and can be a prolific seeder.

GLOBEMALLOW (MANY SPECIES)

Photo Credit: SEINet Portal


Max Licher


Max Licher


Liz Makings


Max Licher

BOTANICAL NAME
Sphaeralcea coccinea, S. parvifolia, S. ambigua, S. grossulariifolia

DINÉ NAME
Azee'nitł'inii, general name for Sphaeralcea spp.

FORM
Perennial wildflower

ELEVATION
Varies by species, found at most

BLOOM TIME
Spring to fall

USES
Standard, erosion control, pollinator, clay

SUGGESTED SEEDING RATE
2 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Globemallows have an impenetrable seed coat and require scarification by submerging seeds in boiling water for 10 seconds. Broadcast seeds in late fall to early spring; do not plant deeper than ¼ inch.

SHORT DESCRIPTION
There are many species of globemallow on the Navajo Nation. All of them have relatively showy distinctive small orange cup-shaped flowers growing along the plant's stem. They typically grow in clusters and can cover large areas but tend to grow with grasses and other wildflowers and rarely grow in pure (single species) stands. They are extremely drought tolerant, like full sun, and grow in a variety of soils. They are a great pollinator plant, and even house native bees on cold nights - look inside the flower cup to find one or more male bees keeping warm.

Photo Credit: Kristin Phillips, SEINet Portal Network

MILKWEED
(MANY SPECIES)

Photo Credit: SEINet Portal Network

BOTANICAL NAME
Asclepias asperula, A. latifolia, A. subverticillata, A. speciosa, A. tuberosa

DINÉ NAME
Ch'ilabe'é, general name for Asclepias spp.

FORM
Perennial wildflower

ELEVATION
Varies by species, found at most

BLOOM TIME
Varies

USES
Pollinator, ornamental

SUGGESTED SEEDING RATE
8 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Various seed stratification needed, from 48-hour water soak to 1 - 2 months cold/moist stratification. If seeding, broadcast in late fall to allow for cold stratification over winter.

SHORT DESCRIPTION
Milkweeds have a distinctive shaped flower like a crown with long tails. All have milky sap. Beyond this, the leaf shape, flower color, and size vary among the species. Milkweeds are the host plant for monarch and queen butterflies and are loved by many pollinating insects and hummingbirds. They generally have large roots and are drought tolerant. The horsetail milkweed (*A. subverticillata*) is weedy and easily grows by seed. Others are best planted by container plants. Most will grow across the Navajo Nation, but butterfly weed (*A. tuberosa*) is better at higher elevations (ponderosa forest).

Photo Credit: Max Licher, SEINet Portal Network

Navajo Tea

BOTANICAL NAME
Thelesperma megapotamicum

DINÉ NAME
Ch'ilgohwéhí'deí

FORM
Annual/short-lived perennial wildflower

BLOOM TIME
March - August

ELEVATION
2,000 - 9,500 ft.

USES Standard, sandy soils, pollinator, clay

SUGGESTED SEEDING RATE
Unknown

SUGGESTED PLANTING METHOD
One month cold stratification or broadcast seeds in early spring.

SHORT DESCRIPTION
A tall, short-lived perennial or annual wildflower, preferring disturbed sites in clay or sandy soils. On the Navajo Nation, often found on roadsides in sandy soils. Distinguished by its thread-like skinny leaves and yellow rayless flowers occurring at the end of stems. Plants in this genus are important for tribes in the Southwest, especially the Hopi and Navajo, who use it to make tea. Traditionally, the method for harvesting Navajo tea is to cut the plant 3 - 4 inches above the ground just as flower buds are opening, so that it has a chance to grow again. Plants are then rinsed, dried, and tied into bundles that are steeped with hot water to make a pleasant grassy-flavored tea. Flowers and roots are used to make a red-brown and yellow-orange dye for basket-making and wool.

Photo Credit: Sue Carnahan, SEINet Portal Network

Photo Credit: Patrick Alexander, SEINet Portal Network

PENSTEMON
(MANY SPECIES)

Photo Credit: SEINet Portal Network


Liz Makings


Max Licher


Max Licher


Max Licher


Megan Swan


Eugene Sturla

BOTANICAL NAME
Penstemon strictus, P. barbatus, P. palmeri, P. eatonii, P. ambiguus, P. comarrhenus

DINÉ NAME
Tsédídéédh, general name for Penstemon spp.
Dah yiitíhidąą', P. barbatus

FORM Perennial wildflower

BLOOM TIME June - October

ELEVATION 4,000 - 8,000 ft.

USES Pollinator, ornamental

SUGGESTED SEEDING RATE 2 - 3 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Better as a container plant. If seeding, seed ⅛ - ¼ inch deep in fall to allow cold stratification.

SHORT DESCRIPTION
There are 250 - 280 species of Penstemon in the United States, and our region has one of the largest centers of diversity for the genus. They are a fairly drought tolerant and are adapted to soils with low organic content. They generally like full sun, however, higher elevation species can cope with some shade. All species of beardtongue are great pollinator plants, attracting many species of bees, butterflies, and hummingbirds. Rocky mountain beardtongue (*P. strictus*): A higher elevation species found in ponderosa pine and spruce fir forests with deep blue flowers. Scarlet bugler (*P. barbatus*): A very common red-flowered Penstemon in mid to upper elevations of the Southwest. Prefers rocky and sandy soils in pinyon-juniper, ponderosa, and pine-oak habitat. Palmer's penstemon (*P. palmeri*): Purple to violet flowered Penstemon found in washes, canyon, pinyon-juniper understory, and at higher elevations. Has great fragrance and is drought tolerant. Eaton's firecracker (*P. eatonii*): A large, robust, scarlet-flowered Penstemon that is fairly drought tolerant. Preferred by hummingbirds. Gilia beardtongue (*P. ambiguus*): A shrubby Penstemon with pale pink flowers found in sand dunes, desert shrubland, and pinyon-juniper understories. Dusty beardtongue (*P. comarrhenus*): A smaller blue to pinkish blue-flowered Penstemon found in Gambel-oak, pinyon-juniper, and ponderosa pine understories.

Pale Evening Primrose

BOTANICAL NAME
Oenothera pallida

DINÉ NAME
Tł'é'yiigáhii, general name for Oenothera spp.

FORM
Perennial wildflower

BLOOM TIME
May - September

ELEVATION
3,500 - 8,000 ft.

USES Standard, Sandy soils, erosion control, pollinator, clay

SUGGESTED SEEDING RATE
1 - 2 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Broadcast in early Spring.

Photo Credit: Tony Frates, SEINet Portal Network

SHORT DESCRIPTION
Pale evening primrose have white, or pale pink flowers in four-parts, which open at night and are pollinated by hawk moths. They are found in sand, disturbed areas, and are fairly drought tolerant. Their showy flowers are reminiscent of tissues strewn across the landscape. There are several similar species of primrose including *O. caespitosa*, which lacks a central stem.

Photo Credit: Max Licher, SEINet Portal Network

Redroot Buckwheat

BOTANICAL NAME
Eriogonum racemosum

DINÉ NAME
Łe'étsoh yiljaa'í

FORM
Perennial wildflower

BLOOM TIME
July - October

ELEVATION
4,000 - 9,500 ft.

USES
Standard, high elevation, pollinator

SUGGESTED SEEDING RATE
Unknown

SUGGESTED PLANTING METHOD
Broadcast seed in the Fall. Seeds need at least one month cold stratification to germinate.

SHORT DESCRIPTION
Redroot buckwheat is a common wildflower in sandy to gravelly soils in grasslands, sagebrush, piñon-juniper woodlands, and ponderosa pine forests. Its leaves are all basal (emerging from ground level). The flowering stems are 30 - 80 cm tall with clustered, small white to pink flowers. Redroot buckwheat provides important habitat for pollinators and wildlife.

Rocky Mountain Beeplant

BOTANICAL NAME
Cleome serrulata

DINÉ NAME
Waa'

FORM
Annual wildflower

ELEVATION
3,000 - 9,500 ft.

BLOOM TIME
May - August

USES Standard, sandy soils, pollinator

SUGGESTED SEEDING RATE
1 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Broadcast seed or drill in early spring

SHORT DESCRIPTION
Tall (2 - 5 ft) wildflower with airy 3-lobed leaves that climb up the flowering stalk. The flower, at the top of the stalk is a showy 'spidery' pom-pom that are lavender-purple, bedecked by long slender seedpods. It flowers continuously from July to August, following monsoonal rains. Can grow singularly or in clusters of many, depending on moisture availability. Common along roadsides and is drought tolerant. The green leaf is a nutritious food when lightly steamed and is also used as a dye. It attracts many species of bees, butterflies, hummingbirds, and is the host plant for the cabbage white moth. Birds also eat the seeds of beeplant.

Hoary Tansy Aster

Photo Credit: Max Licher, SEINet Portal Network

BOTANICAL NAME
Machaeranthera canescens

DINÉ NAME
Unknown

FORM Short-lived perennial to biennial wildflower

ELEVATION
3,000 - 9,500 ft.

BLOOM TIME
July - October

USES Standard, sandy soils, pollinator

SUGGESTED SEEDING RATE
2 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Seed in late fall up to ¼ inch deep.

SHORT DESCRIPTION
Showy purple-flowered daisies with yellow centers. Found on open, sandy sites, frequently growing roadside. These flowers easily colonize disturbed sites and are good choices for increasing pollinator plants on rangelands or for increasing native plant diversity on weedy sites. Other tansy asters coexist in our region, including the nearly identical *M. tanacetifolia*, which differs by its feathery leaves and annual lifecycle.

Photo Credit: Max Licher, SEINet Portal Network

Threadleaf Groundsel

BOTANICAL NAME	DINÉ NAME
Senecio flaccidus	Azeehááldzidí

FORM	BLOOM TIME
Perennial sub-shrub	Spring to fall
ELEVATION	**USES**
2,500 - 7,500 ft.	Sandy soils, pollinator

SUGGESTED SEEDING RATE
Unknown

SUGGESTED PLANTING METHOD
Broadcast seed in Fall.

SHORT DESCRIPTION
Common small shrub (around 2 - 3 ft) with many small yellow daisy-like flowers (yellow petals and yellow centers) that grow at the top of stems in clusters. Leaves are blue-green to green, needle-like and sparse. Seeds are white puffs, similar to dandelion. Very drought-tolerant and likes full sun. An important pollinator plant since it blooms at times when there might not be many flowers on the landscape. Likely a host plant for many native species of butterfly.

Photo Credit: Max Licher, SEINet Portal Network

Western Yarrow

BOTANICAL NAME	DINÉ NAME
Achillea millefolium	Tééhch'ihóózhood

FORM	BLOOM TIME
Perennial wildflower	June - September
ELEVATION	**USES**
5,500 - 11,500 ft.	High elevation, wetland, pollinator, ornamental

SUGGESTED SEEDING RATE
0.5 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Seed no deeper than ¼ inch, needs light to germinate.

SHORT DESCRIPTION
An excellent restoration species that seeds readily in damp, dry, salty, or clay soils. Found in pine understories, meadows, pastures, disturbed sites, roadsides, and along streambanks. Yarrow is in the aster family and has frilly, highly dissected leaves and white umbrella shaped flowering stalks that attract native bees and butterflies. When crushed, the leaves smell like chamomile.

Photo Credit: Paul Rothrock, SEINet Portal Network

White Prairie Clover

Photo Credit: Max Licher, SEINet Portal Network

BOTANICAL NAME	DINÉ NAME
Dalea candida	Unknown

FORM	BLOOM TIME
Perennial wildflower	May - September
ELEVATION	**USES**
3,000 - 8,000 ft.	Standard, sandy soils, erosion control, pollinator

SUGGESTED SEEDING RATE
4 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Seed in early spring at a depth of ½ - ¼ inch. Scarification of seeds with sandpaper improves germination.

SHORT DESCRIPTION
A white clover in the fabaceae (pea) family that provides good forage for livestock as well as browse for deer and elk. However, it is not tolerant of persistent overgrazing. Found in grasslands, woodlands, pine forests, washes, and roadsides on well-drained gravely, sandy, or silty soils. Like all peas, it is a nitrogen fixer and is therefore an important component of prairie and grassland ecosystems.

Photo Credit: Tony Frates, SEINet Portal Network

Antelope Bitterbrush

BOTANICAL NAME
Purshia tridentata

DINÉ NAME
Tsék'ina'ałch'ízhii

FORM
Evergreen shrub

ELEVATION
5,000 - 8,000 ft.

BLOOM TIME
April - June

USES Erosion control, pollinator, ornamental

SUGGESTED SEEDING RATE
1 - 3 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Seed should be planted in the fall or winter at a depth of approximately 1 inch.

SHORT DESCRIPTION
Antelope bitterbrush is a large, evergreen shrub with three-lobed leaves and copious white-yellow, fragrant flowers (flowering in late spring to early summer). It is an important spring and winter forage plant for mule deer, elk, pronghorn, and desert bighorn, as well as domestic livestock. It is also a very important habitat and food source for birds, small mammals, and pollinator insects. Antelope bitterbrush grows in dry, rocky to coarse sandy soils in pinyon-juniper and ponderosa pine forest openings (or as dominant cover). Its drought tolerance and adaptation to a wide range of soils make it a useful species for reclamation and erosion control. Another common species in the same genus on the Navajo Nation is *P. stansburyana*.

Apache Plume

BOTANICAL NAME
Fallugia paradoxa

DINÉ NAME
Unknown

FORM
Evergreen/deciduous shrub

ELEVATION
3,500 - 7,500 ft.

BLOOM TIME
April - October

USES
Erosion control, pollinator, ornamental

SUGGESTED SEEDING RATE
Unknown

SUGGESTED PLANTING METHOD
Generally, no stratification necessary. Occasionally, one month cold stratification is needed if seeds are not germinating.

SHORT DESCRIPTION
Apache plume is uncommon on the Navajo Nation with most natural observations occurring on Western Navajo. It generally grows on rocky-gravelly soil. Where present, this species provides important wildlife and pollinator habitat. Often used as an ornamental shrub.

Big Sagebrush

Photo Credit: Kristin Phillips, SEINet Portal Network

BOTANICAL NAME
Artemisia tridentata

DINÉ NAME
Ts'ahtsoh

FORM
Evergreen shrub

ELEVATION
5,000 - 8,000 ft.

BLOOM TIME
July - September

USES
Standard, ornamental

SUGGESTED SEEDING RATE
Drill seed 0.025 lbs./acre PLS/acre or broadcast seed 0.05 - 0.075 lbs. PLS/acre.

SUGGESTED PLANTING METHOD
Best as a container plant or small proportion of seed mix. Can sow about ⅛ inch deep and press into the soil. Protect seedlings from wind and harsh sun in early stages.

SHORT DESCRIPTION
Sagebrush is an iconic woody shrub around 3 - 10 feet tall with small gray-green leaves and a distinctive aroma. It grows in large stands across much of the Navajo Nation, usually in meadows and valley bottoms. Seeds of sagebrush are typically wild-collected since it is a prolific seeder and difficult to farm. There are several species of sagebrush and subspecies of big sagebrush. The species or subspecies can be a good indicator of the type of soil at your site.

Choke Cherry

Photo Credit: Patrick Alexander, SEINet Portal Network

BOTANICAL NAME
Prunus virginiana

DINÉ NAME
Didzédik'ǫ́zhí

FORM
Deciduous shrub

ELEVATION
5,500 - 9,500 ft.

BLOOM TIME
April - June

USES High elevation, pollinator, ornamental

SUGGESTED SEEDING RATE
Unknown

Photo Credit: Max Licher, SEINet Portal Network

SUGGESTED PLANTING METHOD
Seed should be planted in the fall or early winter at a depth of ½ inches. If planted in the spring or grown as a plug in the greenhouse, the seed should be cold/moist stratified for 3 months prior to planting.

SHORT DESCRIPTION
Chokecherry is a large shrub or small tree with cylindric clusters of small, aromatic, white flowers. It grows in cool habitats such as narrow canyons and mountain forests. It provides an important food source, cover, and nesting habitat to many species of wildlife, including insects, birds, small mammals, deer, and bears. Traditionally used by many tribes as a food source, medicinal, and ceremonial plant. WARNING: SEVERAL PARTS OF THIS PLANT ARE POISONOUS IF CONSUMED.

Photo Credit: Max Licher, SEINet Portal Network

Coyote Willow

BOTANICAL NAME
Salix exigua

DINÉ NAME
K'ei'łibáhí

FORM
Deciduous shrub

BLOOM TIME
March - June

ELEVATION
1,000 - 8,500 ft.

USES
Wetlands, erosion control

SUGGESTED SEEDING RATE
Not typically seeded.

SUGGESTED PLANTING METHOD
Dormant cuttings

SHORT DESCRIPTION
Willows include many species of deciduous shrubs and trees in the Salix family and are typically seen growing near water. Coyote willows typically have many narrow stems, 4 - 8 ft tall, and long narrow leaves. They readily sprout roots wherever they touch moist soil and can form dense thickets, making them great for use as cutting materials for erosion control and restoration.

Four-wing Saltbush

BOTANICAL NAME
Atriplex canescens

DINÉ NAME
Díwózhiiłbéíí

FORM
Deciduous shrub

BLOOM TIME
April - July

ELEVATION
3,500 - 7,500 ft.

USES
Erosion control, clay

SUGGESTED SEEDING RATE
0.25 - 0.5 lbs. PLS/acre

SUGGESTED PLANTING METHOD
Container plant, soak seeds in hydrogen peroxide for 24 hours before cold/moist stratifying for one month.

SHORT DESCRIPTION
Four-wing saltbush is a very common shrub on the Navajo Nation and is easily identified by its narrow pale green leaves and large clusters of four winged seeds. It grows in bottomlands in sandy to gravelly soils. It is an Important browse plant for wildlife and livestock, especially in the winter. Also provides important cover for small wildlife species. Useful in reclamation and erosion control, especially for dry sites due to its deep roots.

Greasewood

BOTANICAL NAME
Sarcobatus vermiculatus

DINÉ NAME
Díwózhiishjiin

FORM
Deciduous shrub

BLOOM TIME
May - September

ELEVATION
4,300 - 6,500 ft.

USES
Erosion control, clay

SUGGESTED SEEDING RATE
Unknown

SUGGESTED PLANTING METHOD
Seed or container plant. Seeds should be planted ½ - ¾ inches deep. If growing in the greenhouse, cold/moist stratify seeds for one month.

SHORT DESCRIPTION
Greasewood is a common shrub found in dry bottomlands. It provides fair forage for cattle and sheep, however, if consumed exclusively without the addition of other species, it can be poisonous. It is useful for reclamation on fine, clay, and saline soils. Several uses for many Southwest tribes, including cooking utensils by the Diné People.

Mountain Mahogany

Photo Credit: Patrick Alexander, SEINet Portal Network

BOTANICAL NAME
Cercocarpus montanus

DINÉ NAME
Tsé'ásdaazii

FORM
Large shrub/tree

BLOOM TIME
March - July

ELEVATION
1,000 - 7,000 ft.

USES
High elevation, pollinator, ornamental

SUGGESTED SEEDING RATE
Not Common

SUGGESTED PLANTING METHOD
Direct sow seeds in the fall. If planting in containers, one month cold/moist stratification can improve seed germination.

SHORT DESCRIPTION
Mountain mahogany is a deciduous tree that is typically seen in higher elevations alongside ponderosa and juniper. It can be fairly nondescript with numerous small (<2 inches) leaves, and a fairly sparse upright growth habit. The seed has long fuzzy corkscrew-shaped tails on the seed. This long fuzzy tail allows the ripe seed to get carried by the wind to bare soil where, provoked by slight changes in humidity, bends and straightens to screw or drill the seed into the ground.

Photo Credit: Max Licher, SEINet Portal Network

Rubber Rabbitbrush

BOTANICAL NAME	DINÉ NAME
Ericameria nauseosa	Ch'ildiilyésiits'óóz

FORM	BLOOM TIME
Evergreen shrub	July - October
ELEVATION	**USES** Standard, sandy soils, erosion control, pollinator, ornamental
2,000 - 8,000 ft.	

SUGGESTED SEEDING RATE
0.025 lbs. PLS/acre, best as portion of seed mix.

SUGGESTED PLANTING METHOD
Broadcast or drill seed in spring or fall. No seed treatment needed.

SHORT DESCRIPTION
Rubber rabbitbrush is a fast-growing shrub that can get up to 6 feet tall. It does not provide great forage for livestock or wild animals and is relatively abundant across the Navajo Nation. It is characterized by bright yellow flowers in the fall and is a great pollinator plant. Some people consider this plant to be a weed, but it's important to note that it can help keep more noxious non-native weeds out and is not known to compete against native plants.

Photo Credit: Max Licher, SEINet Portal Network

Shadescale

BOTANICAL NAME	DINÉ NAME
Atriplex confertifolia	Dá'ák'ǫǫzhdijoolí

FORM	BLOOM TIME
Evergreen shrub	April - July
ELEVATION	**USES**
2,000 - 7,500 ft.	Erosion control, Clay

SUGGESTED SEEDING RATE
Unknown

SUGGESTED PLANTING METHOD
Broadcast or drill seed at a depth of ¼ - ½ inch in the fall (germination rates can vary). Seeds have a thick coat that completely inhibits germination. The seed coat needs to be removed or breached for germination to occur.

SHORT DESCRIPTION
Small spiny shrub up to 3 feet tall with inconspicuous flowers and round papery seeds. The small (< ¼ inch) leaves are silver, roundish, slightly fuzzy, and remain on the shrub year-round. Highly palatable for livestock and wildlife. Often grows in shallow, rocky, and saline soils in badlands - conditions difficult for most other plants to survive in.

Sumac

Photo Credit: SEINet Portal Network

BOTANICAL NAME
Rhus aromatica, R. trilobata

DINÉ NAME
K'jį', Ch'ilɬichiin

FORM
Deciduous shrub

ELEVATION
2,500 - 7,500 ft.

BLOOM TIME
March - August

USES Standard, sandy soils, erosion control, ornamental

SUGGESTED SEEDING RATE
Unknown

SUGGESTED PLANTING METHOD
Direct sow seeds in fall or winter. When growing in containers, seeds should be soaked in sulfuric acid for 60 minutes (sandpaper may be used instead of acid), before being placed in cold stratification for 1 - 2 months. Sumac can also be grown from softwood cuttings.

SHORT DESCRIPTION
Sumac is a shrub up to 9 feet tall. It has many branches covered in 3 lobed leaves. The leaves have a distinct acrid to earthy aroma, particularly distinct when covered in fruit. The female plants produce small pulpy sour red sticky fruits in clusters that are high in vitamin C and can be used to create a lemonade-like tea. Sumac occurs on dry habitats in canyons, sand dunes, forest openings, and even streamside. These also make a nice hedgerow plant and are good erosion control.

Utah Serviceberry

Photo Credit: Zachary Berry, SEINet Portal Network

BOTANICAL NAME
Amelanchier utahensis

DINÉ NAME
Dídzéi dit'odi

FORM
Large shrub to tree

ELEVATION
5,000 - 9,000 ft.

BLOOM TIME
April - May

USES
High elevation, pollinator, ornamental

SUGGESTED SEEDING RATE
N/A

SUGGESTED PLANTING METHOD
Direct sow in the fall at a depth of ¼ inch. 2 - 3 months cold/moist stratification when growing in containers.

SHORT DESCRIPTION
Serviceberry is a shrub to small tree from 2 - 16 feet tall. It has numerous branches with smooth red to ashy-gray bark. It can be inconspicuous except during the spring when the white flowers give way to delicious dark purple berries, which taste similar to a blueberry. Serviceberry is typically found on rocky hillsides, woodlands, and streambanks. It provides good forage for birds and other wildlife and can re-sprout from the root crown.

Photo Credit: Patrick Alexander, SEINet Portal Network

Wax Currant

BOTANICAL NAME
Ribes cereum

DINÉ NAME
K'ínijiłahí

FORM
Deciduous shrub

ELEVATION
6,000 - 12,000 ft.

BLOOM TIME
April - July

USES High elevation, pollinator, ornamental

SUGGESTED SEEDING RATE
Unknown

SUGGESTED PLANTING METHOD
Seeds should be planted in fall or early winter at a depth of ½ inches. If planting in a greenhouse (container), seeds should be cold/moist stratified for 2 - 4 months; soaking in hydrogen peroxide prior to cold stratification may also increase germination.

SHORT DESCRIPTION
Wax currant is a common shrub in forest openings in the mountains of the Navajo Nation. It is distinguished by kidney shaped leaves with serrated edges, trumpet shaped flowers, and orange to red berries. Wax currant is important cover and food source for many species of wildlife. The berries were also consumed by several tribes in the Southwest. Several species of Ribes occur on the Navajo Nation, such as *R. leptanthum*, and have the same general form and habitat, some of these species have spines.

Photo Credit: Patrick Alexander, SEINet Portal Network

Winterfat

BOTANICAL NAME
Krascheninnikovia lanata

DINÉ NAME
Gahtsohdą́ą́'

FORM
Evergreen shrub

ELEVATION
2,000 - 7,000 ft.

BLOOM TIME
May - October

USES
Erosion control, clay, ornamental

SUGGESTED SEEDING RATE
0.5 lbs. PLS/acre.

SUGGESTED PLANTING METHOD
Best seeded in the winter no deeper than ¼ inch deep. Seeds don't typically remain viable when stored for more than 2 years. No seed treatment needed.

SHORT DESCRIPTION
Winterfat is a short shrub 1 - 4 ft tall covered in small dense fuzzy leaves that give the plant a white appearance. It is found on a wide range of soils including in alkaline soils. It is good winter forage for livestock and wildlife.

Photo Credit: Frankie Coburn, SEINet Portal Network

Wood's Rose

Photo Credit: Tony Frates, SEINet Portal Network

BOTANICAL NAME
Rosa woodsii

DINÉ NAME
Chǫǫh

FORM
Deciduous shrub

BLOOM TIME
May - August

ELEVATION
5,500 - 9,000 ft.

USES High elevation, wetlands, pollinator, ornamental

SUGGESTED SEEDING RATE
Unknown

Photo Credit: Max Licher, SEINet Portal Network

SUGGESTED PLANTING METHOD
Direct sow in the fall or 2 - 3 months cold/moist stratification before planting in containers.

SHORT DESCRIPTION
Wood's rose is a common shrub that grows where there is moist well-drained soil. At lower elevations it can be found along streams and inside canyons; at higher elevations it can be found in forest openings and slopes. Often thicket forming. It can be identified by its thorny stems, small serrated leaves and pink, five-petaled flowers. The leaves and rose hips, or fruits, are important food for wildlife.

Photo Credit: SEINet Portal Network

Narrowleaf & Banana Yucca

Wendy Hodgson

Max Licher

Robert Sivinski

BOTANICAL NAME
Yucca angustissima,
Y. baccata, Y. baileyi

DINÉ NAME
Tsá'ászeh or **Tsá'ászi',**
general name for Yucca spp.

FORM Succulent shrub

BLOOM TIME April - June

ELEVATION 3,500 - 8,000 ft.

USES Sandy soils, pollinator, ornamental

SUGGESTED SEEDING RATE
Unknown

SUGGESTED PLANTING METHOD
No seed treatment necessary.

SHORT DESCRIPTION
Yuccas are an easily recognizable succulents with long spear-like leaves that have pointy tips (*Y. baccata* is distinguished by much wider leaves). The Navajo Nation has a handful of species of yucca, which generally grow in sandy soils. Most species flower annually on a stalk up to 4 ft tall covered in big white flowers. The fruits are hard, oblong shaped, and green, about 3 - 5 inches long. The flowers, fruits, and roots can be prepared and eaten. Yucca have a unique symbiotic pollination relationship with yucca moths that is mutually beneficial. The yucca moth lays its eggs in the yucca flower, pollinating it in the process. As a trade-off the moth larvae hatch to eat some of the yucca seeds.

Fremont Cottonwood

Photo Credit: Max Licher, SEINet Portal Network

BOTANICAL NAME
Populus fremontii

DINÉ NAME
T'iis

FORM
Deciduous tree

BLOOM TIME
March - June

ELEVATION
<6,500 ft.

USES
Wetlands, ornamental

SUGGESTED SEEDING RATE
Not typically seeded.

Photo Credit: Sue Carnahan, SEINet Portal Network

SUGGESTED PLANTING METHOD
Dormant cuttings

SHORT DESCRIPTION
Fremont cottonwood is common along lower elevation washes and streams of the Navajo Nation. It is recognizable by large size, deeply furrowed bark, and large, triangular leaves with serrated edges. Cottonwood provide important overstory canopy in riparian areas and provide habitat for many species.

Gambel's Oak

Photo Credit: Aaron Flesch, SEINet Portal Network

BOTANICAL NAME
Quercus gambelii

DINÉ NAME
Tséch'il or chech'il

FORM
Deciduous shrub to tree

BLOOM TIME
April - June

ELEVATION
4,000 - 10,000 ft.

USES
High elevation, ornamental

SUGGESTED SEEDING RATE
Not typically seeded.

Photo Credit: Max Licher, SEINet Portal Network

SUGGESTED PLANTING METHOD
Seeds cannot be stored, sow in fall soon after collecting. If planting seeds in containers, cold/moist stratify until seeds germinate, then plant into container about 1 inch deep.

SHORT DESCRIPTION
Gambel's oak has distinct shiny leathery leaves that are 2 - 6 inches long with 2 - 4 deep lobes per side. It typically grows along with juniper and ponderosa at higher elevations. It produces acorns typical of most oak species. It grows in clusters or thickets and can be low growing and shrub-like around 5 ft or less or more tree-like, up to 40 ft tall.

Photo Credit: Max Licher, SEINet Portal Network

Goodding's Willow

BOTANICAL NAME
Salix gooddingii

DINÉ NAME
Unknown

FORM
Deciduous tree

BLOOM TIME
March - June

ELEVATION
<7,500 ft.

USES
Wetlands, ornamental

SUGGESTED SEEDING RATE
Not typically seeded.

Photo Credit: Sue Carnahan, SEINet Portal Network

SUGGESTED PLANTING METHOD
Dormant cuttings

SHORT DESCRIPTION
Goodding's willow is a large overstory tree with fissured bark and long, narrow, pointed leaves. It grows in wetlands near streams and springs on the Navajo Nation and is important habitat for wildlife. Like most species in the willow family, Goodding's willow grows easily from dormant cuttings, making it useful for riparian restoration.

Photo Credit: SEINet Portal Network

Max Licher

Kristin Phillips

Max Licher

Juniper (Many Species)

BOTANICAL NAME
Juniperus monosperma, J. osteosperma, J. scopulorum

DINÉ NAME
Gad

FORM Evergreen tree

BLOOM TIME April - June

ELEVATION 2,500 - 9,000 ft.

USES Sandy soils, ornamental

SUGGESTED SEEDING RATE Not typical

SUGGESTED PLANTING METHOD
Direct sow in fall or three month cold stratification before sowing in containers.

SHORT DESCRIPTION
The Juniper species are a very common evergreen tree across the Navajo Nation. It is in the pine family and has fragrant scale-like leaves. All species produce recognizable blue-grey "berries", which are actually modified cones typical of gymnosperms. These trees either have male and female cones on the same (*J. osteosperma* and *J. scopulorum*) or different plants (*J. monosperma*). When the male cones are ripe in early spring, juniper pollen can be seen wafting off the trees and being carried by the wind, the trees' main pollinator. Juniper makes great firewood and habitat for many species of wildlife from deer to jackrabbits to birds.

ACQUIRING NATIVE PLANT SEED

Local Adaptation and Cultivars

Plants are locally-adapted to the environmental conditions of their home. Therefore, when choosing seed for use on Navajo Nation lands, seed grown or harvested from the Navajo Nation is preferred because this seed will be uniquely adapted to the climate and biotic and abiotic conditions of the region. Unfortunately, there are no commercial vendors in the Southwest that provide locally-adapted seed specific to the Navajo Nation. However, recognizing the need for locally-sourced native plant material for wildlife habitat improvement projects, the Navajo Nation Department of Fish and Wildlife initiated the Diné Native Plants Program (DNPP) in 2017, with the goal of native plant material production for use in restoration the Navajo Nation. The DNPP focuses seed collecting and plant propagation efforts on widespread "workhorse" species that are important for restoration, and culturally-important species for the purpose of education and preservation of traditional knowledge. For more information on the program and to inquire about seed availability, visit DNPP's website at: https://www.nndfw.org/dnpp/homepage.html

In order to produce the bulk native seed needed to meet market demand, many commercial seed vendors grow native species in an agricultural setting under optimal conditions so that seed can be harvested and cleaned efficiently using specialized equipment. Many of these seed vendors plant ***cultivars***, which lend themselves well to field production and are often selected for certain desirable traits such as vigor and seed production. The cultivars were originally sourced from wild seed collections, usually from a single population or several populations and selected for desirable traits through field trials. Cultivars are identified by a name that precedes the species name. For example:

- *'Redondo'* Arizona Fescue is a cultivar named 'Redondo' which was created from a wild population of Arizona fescue in ponderosa-pine understory near Los Alamos, New Mexico (USDA NRCS 1984). It is recommended for use from CO to TX and NV for elevations of 6,000-10,000 ft.

You can find information about conservation cultivars released by the Natural Resources Conservation Service (NRCS), including their geographic areas of adaptation and recommended uses at:

https://www.nrcs.usda.gov/wps/portal/nrcs/releases/plantmaterials/technical/cp/release/?stype=cname

When choosing seed sources and cultivars, keep the following in mind:

IDEAL
Seed sourced from your ecoregion on the Navajo Nation

PREFERRED
Seed sourced from the Navajo Nation at your project site elevation.

LESS PREFERRED BUT MORE AVAILABLE
Populations or cultivars sourced from AZ, UT, NM, CO, NV, which are recommended for use in your project site elevation.

LESS RECOMMENDED
Seed or cultivars sourced from TX, CA, OK, or northwestern states (MT, ID, WY, OR, WA), which are recommended for use in your project site elevation.

NOT RECOMMEDNDED
Seed or cultivars sourced from what was tallgrass prairie habitat from the Midwestern U.S. or from states not listed above.

Collecting Seed from the Wild

Collecting your own seed from the wild is a great way to get seeds for your personal use and works well for small seeding efforts like a backyard seeding project or pollinator garden. One big advantage that local seed collecting has is that it allows you to ensure that the seeds you're collecting are adapted to your local climatic conditions. It is possible to collect enough seed from wild populations for larger projects, but it might take quite a bit of effort to find large enough populations to collect from. The tops of mesas and anywhere cattle and livestock can't get to are great places to look for seed. *One key thing to keep in mind when collecting seed is to not collect more than 20% of the viable seed from the population.* That way at least 80% of the seed is left on-site to keep seeds in the soil seed bank for new seedlings to proliferate as well as food and forage for wildlife and insects. An excellent resource for seed collecting, as well as seed processing and storage, is the USDA Forest

Service's Nursery Manual for Native Plants: A Guide for Tribal Nurseries, Chapter 7. This manual is accessible online at: https://www.fs.fed.us/rm/pubs_series/wo/wo_ah730.pdf. Here are some basic steps to get started with seed collecting:

1. **Know your species:** It's crucial to know which species you're collecting so that you'll know if you want to collect it in the first place! Many of the plants out on Navajo Nation are introduced or weedy invasive species and you don't want to facilitate their spread. Another reason to know your species is to know what type of seeds it has, what the mature seeds look like, and when to time your collecting. Plants have a lot of different types of seed; from fleshy fruits like rose hips to winged fruits of maples to spores of ferns. Each of these types of fruits look different at maturity and will require different collecting supplies as well as different post-collection processing and storage techniques. See Additional Resources section for plant identification resources relevant to the Navajo Nation.

2. **Timing is Key:** It can be difficult to know what the mature seed of your collecting species looks like, and many novice collectors end up collecting empty seed heads or immature seed. Some species, like willows and saltbush, are dioecious, meaning that male and female flowers are located on different individual plants. Collecting fruit from these species requires collecting from the female individuals in a population only. Do some research to find out what the mature seed of your target species looks like and figure out approximately when the seeds will be ripe. Seed collecting often requires several trips to a population to check the timing of seed ripeness before harvesting.

3. **Collecting is low-tech:** Once you've found your population, identified your species, and timed your collecting for when mature seed is ready, you are ready to collect! The actual collecting is straightforward and most of the time your most valuable piece of equipment is a lunch-sized paper bag, or larger grocery-store paper bag for larger populations or larger seed. Gently run your hands over the seedheads (gloves are helpful) to loosen mature seeds into your paper bag, making sure not to collect more than 20% of the seed on each plant. Depending on your target species, you may need to pick fruits individually (for example, primrose and penstemon), or you may need additional equipment (it's helpful to have a plastic bag for species with very wet fruits). Some fruits may be easier to collect with a tarp and an old tennis racquet (for example saltbush and antelope bush). Make sure to label your bags with the species name, location, date, and any population notes (associated species, soil type, population condition, etc.) and to close your bag with a binder clip so that the seeds don't escape.

4. **Post-Processing:** There are two types of seed, recalcitrant and orthodox. Recalcitrant seeds cannot be stored for

long and only remain viable for days, weeks, or months after collecting and are generally sown immediately after collection. Examples of recalcitrant species include willow, cottonwood, aspen, black walnut, and many aquatic species (Dumroese et al. 2009) Orthodox seeds can tolerate drying and therefore can be stored for much longer, even years under the right conditions. For orthodox seed, it is important to ensure that your collected seeds are 1) dry, and 2) pest free. Fleshy fruits and cones should be kept in a cooler after collecting to keep seed from fermenting and cleaned as soon as possible. Most of the seeds in our region can be left in their paper bags or envelopes someplace indoors to dry, if the collection is small enough. For larger collections or seed collected in damp conditions (not recommended), seed can be spread on a screen or tarp, and may need to be turned several times a day to allow even drying. Seed pests and predators are commonly collected by accident and can eat through your collection if allowed. Place seeds in a freezer for 24 hours to kill any insects that may eat your collection.

5. **Cleaning and Storage:** When wild collecting seed, you will often collect a lot of stems, seed appendages, and other plant parts in your bag, in addition to your target seed. In order to save space and accurately know how many seeds you have, we recommend "cleaning" your seed collections to remove the extra non-seed material. The way you clean your seed collection will vary depending on the size and type of seed, so be creative. One of the most common tools we use to separate material from the seed are metal sieves or screens with varying mesh sizes. We rub the collection over the sieve with enough force to break apart the extra stems and debris, but not damage the seed. The smaller material will fall through the mesh into a collection bin and the larger will stay in the sieve. Repeating this process with different sized mesh will leave you pure seed ready for storage.

Seed Vendors in the Southwest Region

Provided is a list of seed vendors (Table 3) serving the SW Region. Make sure you're buying in PLS weights and if you're buying a lot of seed, we recommend getting quotes from several vendors because prices can vary considerably (USDA NRCS 2009). Don't buy your seed pre-mixed, keep everything in a separate bag and mix it yourself. That way you know you've received everything you ordered. Beware that many of these seed vendors sell non-native species, which we DO NOT recommend.

Another useful resource for finding seed vendors in your area is the National Nursery and Seed Directory created by the United States Forest Service (USFS) Reforestation, Nurseries, and Genetics Resources (RNGR) program. The directory is searchable by state and can be found at https://rngr.net/resources/directory

Table 3. *Seed Vendors in the Southwest Region. Availability of native seed can vary year to year and by quantity needed. We recommend reaching out directly to seed vendors to what species are available.*

Vendor	Website	Phone	Notes
Arkansas Valley Seeds, Inc.	www.avseeds.com	(877) 907-3337	
Bamert Seed Company	www.bamertseed.com	(806) 639-5232	Large quantities
Clyde Robins Seed Company	www.clyderobin.com	(510) 315-6720	
Comstock Seed	www.comstockseed.com	(775) 265-0090	
Curtis and Curtis Seed	www.curtisseed.com	(877) 907-1806	
Granite Seed Company	www.graniteseed.com	(801) 768-4422	Large quantities
Native Seeds/SEARCH	www.nativeseeds.org	(520) 622-0830	Small quantities
Pawnee Buttes Seed Inc.	www.pawneebuttesseed.com	(800) 782-5947	
Plants of the Southwest	www.plantsofthesouthwest.com	(505)344-8830	Small quantities
Prairie Moon Nursery	www.prairiemoon.com	(866) 417-8156	Small quantities
Prairie Nursery	www.prairienursery.com	(800) 476-9453	Small quantities
Sharp Bros. Seed Co.	www.sharpseed.com	(800) 421-4234	Large quantities
Southwest Seed	www.southwestseed.com	(970) 565-8722	
Stevenson Intermountain Seed	www.stevensonintermountainseed.com	(435) 283-6639	
Theodore Payne Foundation	www.theodorepayne.org	(818) 768-1802	Small quantities
Turner Seed Company	www.turnerseed.com	(254) 559-2065	
Western Native Seed	www.westernnativeseed.com	(719) 942-3935	Small quantities
Wild Seed Farms	www.wildseedfarms.com	(830) 990-8080	

SEEDING

No matter your seeding method, make sure you're keeping livestock off your seeded pasture or site for at least three years following treatment! This will allow your tiny grasses to put down roots and get established before grazing occurs. The following section provides information on the various methods, equipment, and calculations for seeding projects.

Seeding Methods

Broadcast: Broadcast seeding means hand-dispersing your seeds or dispersing them using a mechanical method, and is a low-cost, effective method for spreading seed, especially on slopes, riparian areas, small sites, or places where drill seeding is not an option. The key to successful broadcast seeding is proper preparation of your project site (see site preparation section) and ensuring good soil contact of your seeds by raking or rolling them into the ground after seeding. It can be difficult to spread seed evenly across your project site, especially if your seeds are small. However, mixing them with about equal parts local soil can make it easier to achieve full coverage. If you are broadcast seeding, typically you'll want to seed at a higher rate than drill seeding, to account for seeds lost to predation by rodents, insects, etc. There are several "seed slinger" products available to assist with broadcast seeding if your site is larger and/or you want to maximize even coverage.

Seed slinger products such as these pictured from Truax Company, Inc. can be hand cranked or mounted to an ATV for broadcast seeding larger sites (photo credit: https://www.truaxcomp.com/seed-slinger/)

Drill Seeding: Drill seeding requires the use of a seed drill pulled behind a tractor or ATV to mechanically place (plant) seeds into the ground at a pre-set depth. For our native species, typically the preferred depth is ½ to ⅛ inches deep but see species descriptions for suggested planting depths. Seeding species too deep will likely result in germination failure and it is therefore extremely important to calibrate and adjust your drill to your specific species mix according to your equipment manufacturing guidelines. Drill seeding is the preferred method for restoring native pastureland, agricultural sites, or large restoration project sites (greater than 1 acre); if the site is accessible to a tractor or ATV. Rocky, sloped, or brushy sites are likely not suitable for drill seeding. There are two types of seed drills commonly available: 1) a grain drill, typically used for common crop species such as wheat and oats, 2) a grassland seed drill, which has multiple seed boxes for different types of seed. For drill seeding native species, a ***no-till grassland seed drill*** is recommended because native seeds have variable sizes, textures, and weights, which will not feed smoothly through a grain drill. No-till means that the drill can operate in an unprepared site which does not require prior soil tillage.

The "Dew Drop Drill," an example of a ATV-pulled drill seeder created for native species planting (photo credit: http://www.dewdropdrill.com/About-Us.htm), and an example of a no-till grassland seed drill for a tractor by CrustBuster Seed King, Inc. (photo credit: https://crustbuster.com/conservation-drills/).

Seeding Rate

PLS is an acronym for "Pure Live Seed" which is the amount of actual live seed per pound of bulk seed. Bulk seed weights include non-viable seed, chaff and debris. Therefore, to calculate the pounds of seed needed to achieve a desired seeding rate of at least 30 viable seeds per sq ft, PLS should be used instead of bulk weight. When purchasing seed, make sure you're buying in PLS and not in bulk seed weight.

Your seeding rate depends a lot on your conservation goals for the site, topography, seed availability, cost, and seeding method. Typically, for conservation seeding projects where the goal is to establish native plant cover and improve wildlife/pollinator habitat, the recommended rate is approximately 30 - 60 seeds per sq. ft. (Rebhahn, 2020). We recommend seeding at the lower rate (30 seeds per sq ft) if you are drill seeding or have a way to ensure good soil contact (raking, rolling, etc.), have a relatively flat site, or if there are already native plants established at your site and the seeding goal is to increase species cover and diversity. Adjust your rate up to 60 seeds per sq ft if you're seeding in a place where a lot of erosion is expected (i.e., a hill or wash), using the broadcast method without a lot of site preparation, seeding into a weedy site with extensive invasive plant competition, or if the goal is to have dense native plant coverage.

Your seed vendor will usually provide the estimated number of seeds per pound by species, which allows you to calculate your pounds PLS/acre for each of your species in order to achieve your desired seeding rate for your project site. For example, if you want to seed Western yarrow (*Achillea millefolium*) over one acre at a rate of 30 seeds/sq ft, calculate your pounds PLS needed using the following formula (USDA NRCS 2011):

- There are 43,560 sq ft/acre. To seed Western yarrow at a rate of 30 seeds/sq ft, you'd need 1,306,800 seeds/acre (43,560 sq ft x 30 seeds/sq ft = 1,306,800 seeds/acre).
- According to your seed vendor, there are 2,770,000 seeds/lbs. for western yarrow. Therefore, you would need: (1,306,800 seeds/acre) / (2,770,000 seeds/lbs.) = 0.47 lbs. PLS/acre

Calculating Seed Rates for Seed Mixes

If you don't want to calculate your own seeding rates, we have included recommended PLS (usually a range) for each species in the species descriptions section. These recommended PLS rates are from the NRCS USDA Plants Database

"Fact Sheets" for each species. If no fact sheet exists for the species, we calculated the estimated PLS range based on a low seeding rate of 30 seeds/sq. ft. and a high seeding rate of 60 seeds/sq. ft. using vendor estimates of numbers of seeds/pound for each species.

When calculating seeding rates for mixes, use the guide below (Table 4). For monoculture (single species) seeding, use the recommended PLS rates in the species descriptions. Note, if a range, see discussion in the seed rate section on when to use a higher or lower seeding rate.

1. **Step 1:** Using the Seed Selection table, choose your species for your seed mix.
2. **Step 2:** Determine your seeding rate in lbs. PLS/acre for each species. These rates are found in the species descriptions section of this document under "suggested seeding rate".
3. **Step 3:** Determine the percentages of each species to include in your species mix, which will vary depending on your conservation goals or the intent of your seeding project. Cost is a large factor when considering percentages of each species, as well as project size. Wildflower and shrubs are usually much pricier than grasses, especially species that are less commonly commercially available. For a general all-purpose range mix, we recommend at least 60-80 percent grasses, 10-20 percent shrubs, and 5-15 percent wildflower. However, if the goal is to create pollinator habitat, wildflowers should be at least 75 percent of the overall mix (Lee-Mader et al. 2013).
4. **Step 4:** Calculate your PLS Seeding Rate/acre by multiplying the Recommended lbs. PLS/acre by the % of Mix. For example, in the table above, Arizona fescue has a Recommended lbs. PLS/acre of 4 and it will comprise 20% of the seed mix (4 lbs. PLS/acre x 20% = 0.8 lbs. PLS/acre).
5. **Step 5:** Multiply your PLS seeding rate/acre by the total acres in your project area to calculate the total lbs. PLS required to complete our seeding project.

Table 4. *Example seed mix calculation determining lbs. PLS/acres needed for each species in the mix. (Adapted from Figure 4, USDA NRCS 2009).*

Plant Species	Functional Type	Recommended lbs. PLS/acre (Species Description)	% of Mix	lbs. PLS Seeding Rate/acre	Acres	Total lbs. PLS Needed
Arizona fescue	Cool season bunchgrass	4	20	0.8	2	1.6
Indian ricegrass	Cool season bunchgrass	10	20	0.8	2	1.6
Blue grama	Warm season bunchgrass	2	20	0.8	2	1.6
Alkali sacaton	Warm season bunchgrass	0.5	20	0.1	2	0.2
Blanket flower	Perennial wildflower	4	7	0.28	2	0.56
Globemallow	Perennial wildflower	2	7	0.28	2	0.56
Western Yarrow	Perennial wildflower	0.5	6	0.03	2	0.06
	Total		**100**	**3.09**	**2**	**6.18**

CONTAINER PLANTING

An alternative to broadcast seeding directly into a revegetation site is to grow plants in containers in a greenhouse, then plant the seedlings into your site once established. There are several factors to consider when growing native plants in containers:

1. **Growing Media (Soil):** Use sterile growing media when sowing seeds so you don't spread diseases, pests, or unwanted seeds/plants with your container plant. You can purchase pre-packaged soil mixes, or you can mix your own. Regardless, you want your soil mix to balance adequate drainage and moisture retention by adjusting the ratio of components. A common mixture is 1 part peat moss, 1 part perlite, and 1 part vermiculite. Peat moss and vermiculite will help retain moisture and the perlite provides proper drainage.

2. **Breaking Seed Dormancy:** Seeds of native plants, especially in arid regions like ours, have protective coatings that help them survive in nature. Seeds may have any number of seed dormancy strategies, including tough impermeable seed coats and underdeveloped embryos that require a treatment to kickstart growth. Removing dormancy mechanisms is important for starting native seeds in containers. There are many ways to break dormancy, cold stratification and scarification are two commonly used techniques.

    a) ***Cold Stratification*** - This method tricks the seed into thinking the winter weather has come and it is time to go dormant. Some native seeds need this period of cold conditions to break dormancy. Place seeds in a refrigerator (or outside) 34-39°F for 1-2 months before sowing (or after sowing). Plant species that grow in higher elevations typically need a longer period of cold stratification.

    b) ***Scarification*** – Scarification helps break the hard seed coat surrounding the seed to allow water and oxygen to enter. This method mimics fire, extreme temperatures, digestive acids in animal stomachs, and scraping over sand or ice. Use one or a combination of the following methods to scarify seeds: 1) Gently rub seeds on sandpaper (100-400 grit are common) until the seed coat is ruptured (be careful not to damage the seed inside), 2) soak seeds in hot water overnight, or 3) soak seeds in a solution of a chemicals, such as gibberellic acid or hydrogen peroxide, before sowing

3. **Sowing:** A general rule of thumb is to plant seeds at a depth 2 times as deep as the seed is wide. Larger seeds will need to be planted deeper than smaller seeds.

4. **Watering:** The soil media must stay moist in order for your seeds to germinate. Keep the soil media moist until your seeds have sprouted. Once your seedlings have created roots, reduce the amount of time you water and only water when the soil is dry. Overwatering will lead to root rot and can kill your plants.

5. **Fertilizer:** Native plants do not require heavy fertilizers. Many thrive in low nutrient soil and applying fertilizer could chemically burn them. A mild, slow-release fertilizer can be used to jumpstart seedlings that are growing in a greenhouse environment, but fertilizers should be flushed out of the plants system prior to planting in the field.

6. **Hardening Off:** Seedlings grown indoors need time to gradually adjust to the strong sunlight, cool nights, and windy conditions of the outdoors. Set your seedlings outside in a partially shaded area for 1-2 weeks prior to planting in the field.

TIPS FOR PLANTING SUCCESS

Warning! Most seeding projects in drylands fail! Factors such as topography, rodent and insect predation, precipitation, competition from invasive species, timing, soil type, solar exposure, seeding methods, species choice, and more can all influence your chances of success. Precipitation and weather conditions are variable here on the Navajo Nation and taking advantage of high-moisture events is a good way to maximize your germination success. Another good way of hedging your bets is to seed about half your mix at one time and reserve the other half for later supplemental seeding as needed. Below are some additional tips to improving your seeding success.

Site Preparation

Weed Control

If you have a lot of non-native invasive plants at your seeding site, then some additional site preparation prior to putting out your seeds is essential to getting your natives to grow and establish. This is particularly true for persistent patches of invasives (where overall weed cover is more than 50%), or for sites dominated by sod forming grasses and rhizomatous perennial plants like knapweed and Canada thistle. Generally, weed control techniques fall into the following categories: **manual**, using hand tools to cut, dig, or pull weeds; **mechanical**, using power tools such as tractors, chain saws, and plows to cut, dig up, or clear invasive plants (might need a permit); and **chemical,** using species-specific or general herbicides to kill or control weeds (need proper permits and not recommended for most projects). There are also **cultural controls**, which include techniques like prescribed fire (we don't recommend), targeted grazing, mulching, and cover cropping.

The first step to figuring out which method of weed control to use is to identify your weed species and make sure that it is a weed! For example, there are several native thistle species that can look similar to invasive exotic thistles. There are many good electronic and hardcopy

resources for weed identification on the Navajo Nation. If in doubt, contact your nearest USDA Natural Resource Conservation Service (NRCS) office. Take a look at your seeding site and decide which weed control method will work best for your site and weed species. If it's a particularly aggressive species or large infestation, sometimes using multiple weed control techniques is necessary.

Weed control projects involving the use of herbicides and heavy ground disturbance associated with mechanical treatments such as tilling, blading, and grubbing need proper permits and authorizations from Navajo Nation EPA, Navajo Department of Fish and Wildlife, and Navajo Historic Preservation Department. Any projects using restricted use pesticides must have certified pesticide applicators through NNEPA.

For low-tech solutions to treating small (less than 1 acre), patchy weed populations without the use of herbicides or heavy equipment, we recommend the following:

1. **Manual control:** Hand pulling weeds is often an effective way to control smaller or patchy infestations. The goal of hand pulling is to remove as much of the roots as possible while minimizing soil disturbance. For example, invasive thistle roots need to be severed at least 2-3 inches below the soil line to keep plants from resprouting from the root crown. It's a good idea to pull your weeds before they develop seedheads to try and keep weed seeds out of the soil seed bank. For larger woody weeds, it may be helpful to purchase a tool such as a weed wrench (www.theuprooter.com), which works by gripping the base of your weed and using leverage to pull its roots from the ground. Weed wrenches have also been successfully used for hand-pulling smaller Russian olive and tamarisk.

2. **Solarization and sheet mulching:** This technique can be resource intensive and works best for smaller (less than ½ acre), sunny, and relatively flat sites. Essentially, all weeds are cut to ground level by hand or with a mower and then UV-stable plastic of 4 to 6 mm thickness is rolled out onto the site, secured with rocks or ground staples, and left for at least 6 months and up to 12 months. The soil under the plastic is heated by the sun, which eventually kills the weeds underneath and weed seeds in the soil if left for long enough. A drawback to this technique is that UV stable plastic is typically pretty expensive but can be reused on multiple sites. Old used billboard plastic from Phoenix can also be used and is typically free. A low or no cost alternative is to use a sheet mulching technique, which has the advantage of also improving your soil prior to seeding. Sheet mulching can be used in conjunction with solarization. Sheet mulching involves layering nitrogen and carbon layers to smother weed seeds and prevent germination. A layer of non-glossy cardboard is typically placed directly on top of the mowed weed patch and soaked with a sprinkler or hose. The cardboard layer is then followed by a nitrogen-based layer of compost, grass cuttings, or manure, then topped again by another layer of cardboard. This is repeated 1-2 more times, soaking everything in between with water, and ending with a heavier cardboard layer on top to hold everything down. Let your sheet mulch site rest for at least one year to smother weeds and decompose before seeding with natives.

3. **Targeted Grazing:** Targeted grazing involves restricting cattle, sheep, or goats to a specific site using temporary fencing so that they are aggressively grazing a specific undesirable weed species. Targeted grazing has been used to effectively control invasive thistles, knapweeds, and leafy spurge, among other

species. It is not recommended for controlling camelthorn, annual bromes, and jointed goatgrass. The key to using targeting grazing as an effective weed control is 1) timing of the grazing so that animals are on-site when the weed is in a specific life stage, and 2) using the right animals to control a specific weed species. Generally, targeted grazing works best during early Spring growth before flowering when weeds are just emerging from the soil. If seed heads have developed on weed species during grazing, livestock need to be quarantined for at least 24 hours in a corral so that animal feces can be sequestered and burned. Sites may need to be intensively grazed every year for up to five years for effective management.

Ground Disturbance

When seeding native species, you want to ensure that the seeds have good contact with the soil. To keep seeds where you want them, we recommend prepping your site with a little light ground disturbance. This ensures that most of your seeds are not blown away by wind or immediately eaten by birds. Hand raking your site with a wire rake prior to and immediately following seeding is an extremely effective way of ensuring your seeds make contact with the soil. A small tiller or cultivator could also be used in an agricultural setting (pasture or farmlands). However, be warned that too much soil disturbance could generate ideal conditions for weed germination, which will compete with your native seeds. Other methods include:

1. **Pitting**: Creating indentations or pits in the soil can capture and retain moisture to support germinating seeds. This technique is similar to the waffle gardening technique accredited to the Zuni and Hopi. To create a pit, dig a small shallow basin about 4 inches deep and up to 12 inches wide. Lightly pack down the sides and top so the soil doesn't easily fill the pit. See the photo of four pits that remain wet after a rainstorm. Learn more about how this technique is being tested for ecosystem restoration at www.usgs.gov/sbsc/restorenet

2. **Mulching:** Once seeds are spread and raked or tilled into your site, it's a good idea to apply a mulch such as sterile straw (make sure it does not have seedheads which will compete with your seeds), or finely chopped bark or woodchip layer to the site. A light (½ inch deep or so) mulch layer will: 1) retain soil moisture and moderate soil temperatures, and 2) help suppress weed seeds from germinating.

Timing

The timing of your seeding treatment is one of the most important aspects to getting the most out of your native seeds and maximizing germination success. Many of our native wildflower and grass species require a period of cold stratification in order to germinate. Some seeds require a period of cold and wet and others require warm and moist conditions to break dormancy. Perennial native bunchgrasses of our region are generally **warm season** grasses or **cool season** grasses. Warm season grasses require warm soil temperatures (above 60 degrees F) to germinate, which typically occurs in late spring or early summer. Cool season grasses are more tolerant of cooler spring soil temperatures and are often the first to start growing in the spring. Generally, warm season grasses are more tolerant of drought conditions than cool season grasses.

The Navajo Nation receives most of its moisture in a bimodal (two interval) distribution, with winter precipitation originating from the Pacific Ocean and summer moisture originating from the Southwestern summer monsoon. Spring and fall are typically dry seasons for the Nation. Average annual precipitation ranges from 15 cm in lower elevations to over 40 cm for high elevation areas (Tully-Cordova et. al. 2018).

Since seeds require moisture to germinate, seeding should occur when there is a lot of moisture available in the soil. Furthermore, in order to meet cold stratification requirements of many of our native species, we recommend seeding your natives in early **July through early to mid-September**, depending on the timing of monsoonal moisture patterns, which can vary significantly year to year. Summer/fall seeding will allow seeds that do require cold stratification to meet this requirement naturally over the winter, with the expectation that these seeds will germinate the following Spring.

A downside to the monsoonal seeding timing is that seeds will be exposed to predation from rodents and insects for longer periods of time. Another option is to artificially cold-stratify your seeds by mixing them with at least ¼ cup of moist sand (sand should be moist enough to retain a ball shape but not be fully saturated with water) and placing this mix in a labeled zip lock bag in your refrigerator for at least one month prior to seeding. Artificially cold-stratified seeds can then be planted in **March-early June** when soils have warmed. However, *not all species need cold stratification, check the species descriptions section to see if your species has special requirements*. Seeds planted in early summer should be given supplemental moisture.

ADDITIONAL RESOURCES

- Diné Native Plants Program (DNPP) website: https://www.nndfw.org/dnpp/homepage.html
  Information on current DNPP events and workshops, reports, restoration resources, projects, digital copy of handbook, etc.

- University of Arizona EcoRestore Portal website: https://ecorestore.arizona.edu/
  Extensive resources and information on ecological restoration in the arid Southwest. Including an online restoration assessment tool that allow users to input elevation, site characteristics, and restoration goals to generate a recommended plant species list.

- Rogue Native Plant Partnership website: https://www.roguenativeplants.org/seeding-your-site-methods-rates-and-more/, also https://www.roguenativeplants.org/organic-site-preparation-for-wildflower-establishment/
  Good resources on seeding rates and site preparation.

- USDA Forest Service's Nursery Manual for Native Plants: A Guide for Tribal Nurseries. Accessible online at: https://www.fs.fed.us/rm/pubs_series/wo/wo_ah730.pdf

- Xerces Society "Organic Site Preparation for Wildflower Establishment": https://www.xerces.org/sites/default/files/2018-05/15-020_02_XercesSoc_Establishing-Pollinator-Meadows-from-Seed_web.pdf

- American Meadows website: https://www.americanmeadows.com/blog/2018/03/07/how-to-cold-stratify-seeds
  Non-native seed vendor, however, good resource on how-to cold stratify seeds before planting.

Plant Identification on Navajo Nation:

- "Flora of the Four Corners Region, Vascular Plants of the San Juan River Drainage: Arizona, Colorado, New Mexico, and Utah" by Heil, K., S. O'Kane Jr., L. M. Reeves, and A. Clifford.
  Technical botanical flora of the San Juan River drainage that covers a large part of the Navajo Nation. An excellent resource for identifying plants using dichotomous keys.

- Smartphone Apps: "Arizona Wildflowers" and/or "New Mexico Wildflowers"
  Great smartphone apps that allow users enter plant characteristics and return plants that match that description. Also includes descriptions and pictures.

Ecoregion Descriptions:

- Griffith, G.E., Omernik, J.M., Johnson, C.B., and Turner, D.S., 2014, Ecoregions of Arizona (poster): U.S. Geological Survey Open-File Report 2014–1141, with map, scale 1:1,325,000, http://dx.doi.org/10.3133/ofr20141141.

- Griffith, G.E., J.M. Omernik, M.M. McGraw, G.Z. Jacobi, C.M. Canavan, T.S. Schrader, D. Mercer, R. Hill, and B.C. Moran. 2006. Ecoregions of New Mexico (2-sided color poster with map, descriptive

text, summary tables, and photographs). U.S. Geological Survey, Reston, VA. Scale 1:1,400,000. Species

Species descriptions and ecology:

- SEINet. Website: http://swbiodiversity.org/
- Heil, K., S. O'Kane Jr., L. M. Reeves, and A. Clifford. 2013. Flora of the Four Corners Region, Vascular Plants of the San Juan River Drainage: Arizona, Colorado, New Mexico, and Utah. Missouri Botanical Garden Press

Diné plant names and cultural uses:

- Mayes, V.O. and B.B. Lacy. 1994. Nanise' A Navajo Herbal, One Hundred Plants from the Navajo Reservation. Navajo Community College Press.
- New Mexico State University. 2018. Selected Plants of Navajo Rangelands with Navajo Names. Accessed online 21 December 2021. Website: https://navajorange.nmsu.edu/

Seeding rates and planting information:

- USDA Plants database. Website: https://plants.usda.gov/

Additional Citations:

- Dumroese, R. Kasten; Luna, Tara; Landis, Thomas D., editors. 2009. Nursery manual for native plants: A guide for tribal nurseries - Volume 1: Nursery management. Agriculture Handbook 730. Washington, D.C.: U.S. Department of Agriculture, Forest Service. 302 p.
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- USDA NRCS. 2009. Calculating Seed Mixtures-Steps to Guide You in Developing Conservation Seed Mixtures. Plant Materials Technical Note No. 12, Alexandria, Louisiana.
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- USDA NRCS. 1984. Release Brochure for 'Redondo' Arizona fescue (Festuca arizonica). Los Lunas Plant Materials Center, Los Lunas, NM 87031. Edited: 9 MAR 2021.
- Williams, A.P., B.I. Cook, and J.E. Smerdon. 2022. Rapid intensification of the emerging southwestern North American megadrought in 2020–2021. Nature Climate Change, 12(3), 232-234.

GLOSSARY

Abiotic: Nonliving physical and chemical attributes of a system or community. For example, geology, light, temperature, wind, pH, elevation, etc.

Alkali or Alkaline soils: Are clay soils with high pH (greater than 8.5) or are soils which have a high percentage of sodium, or both. Alkali soils are challenging places to grow crops, but several native plants in our region are adapted to alkali conditions and can survive quite happily.

Annual: Plants which are not cold-hardy and will not survive the winters in our region. Annuals of our region have evolved to flower and set seed in a single growing season and are capable of resprouting from the seedbank in spring. Classic examples include sunflowers and cheatgrass.

Basal: Refers to the base of a structure. Plants with basal growth have leaves that form a circle around the stem, all growing at the same height.

Biennial: Plants which require two growing seasons to complete their lifecycle. Typically, vegetative growth occurs in year 1 and flowering does not occur until year 2. Hollyhocks and foxgloves are classic garden examples.

Biotic: Living or once-living components of a system or community.

Bunchgrass: Grasses that grow in a tussock or bunch shape instead of forming a sod or lawn. Many of our native grasses are bunchgrasses, which are typically perennial, long-lived, and have developed root systems.

Cool season: Species of plants, usually grasses, that are in active growth beginning in early spring and go dormant in late fall. They usually go dormant (turn brown) in the heat of summer and green up again when monsoons hit our region.

Cultivar: A plant that has been propagated deliberately to retain desirable characteristics of the parent. When applied to native plants, this usually means that wild-collected seed was grown under production and selected for various characteristics such as drought tolerance, uniform size, uniform seed ripening, root growth, etc.

Cutting: A piece of the plant (usually stem, root, or sometimes a leaf) that is used for vegetative or asexual propagation, which will become a clone of the original plant.

Dormancy: A state of metabolic inactivity when plants conserve resources during adverse growing conditions such as winter or drought. Leaves and foliage may die back at this time making the plant appear to be dead, but roots remain alive and ready to resume growth in the spring or when rainfall returns.

Forb: Flowering, non-grass, herbaceous plants which have stems and leaves that die back at the end of each growing season. Also known as “wildflowers”. Forbs can be annual, biennial, or perennial.

Gymnosperm: Meaning “naked seed”. A vascular plant that reproduces by seeds that are unprotected by an ovary or fruit, which means borne in cones for many gymnosperms. Think of a pinyon pinecone. Flowering plants or **angiosperms** have seeds which are enclosed by mature ovaries or fruits. Think of an apple. However, there are “non-typical” gymnosperms that have modified cones that look more like

angiosperm fruits, like the fleshy “fruits” of ginkos and junipers. Gymnosperms evolved prior to angiosperms and contained some of the earth’s oldest plants.

Perennial: Cold-hardy plants, typically with developed root systems that will survive the winters in our region, usually with a period of dormancy, and will come back again in the Spring.

PLS: Stands for Pure Live Seed, which is the estimated amount of living seed present of the desired species in a given seed lot or bag. PLS accounts for the weight of impurities, chaff, dust, and weed seed that may also be present, and also accounts for the germination rate of the desired species seed.

Recalcitrant: Seeds that do not survive drying or freezing and cannot be stored after collection because they lose their viability. Compare with **orthodox** seeds, which will survive drying and freezing and can survive months or even years of storage without losing significant viability (depending on the species and storage conditions).

Rhizomatous: Plants capable of spreading by rhizomes, which are horizonal underground plant stems. Rhizomatous plants are able to sprout new stems and roots off of these underground stems as a method of asexual reproduction. Classic examples are aspens, bamboo, and ginger.

Scarification: Weakening, opening, or altering the coat of a seed to assist germination. This is accomplished mechanically (for example, using sandpaper), thermally (with cold stratification), or chemically (with hydrogen peroxide or gibberellic acid).

Spikelet: The basic unit of a grass inflorescence, which are the flowering parts of a grass.

Stratification: Pre-treating seeds, usually with cold, moisture, and/or time, to simulate natural conditions to break seed dormancy and initiate germination.

Stolon: A horizonal stem that grows above-ground and is capable of producing new asexual vegetative growth by budding. A classic example of a plant with stolons is a strawberry.

Sub-shrub: A small woody plant, typically perennial.

Warm season: Species of plants, usually grasses, that are in active growth beginning in late spring and go dormant in early to mid-fall (late Sept-Oct). They need warmer spring nights to “green up” than cool season varieties and tend to prefer full sun.