

SITE EVALUATION AND SPECIES SELECTION FOR NEW MEXICO
CHRISTMAS TREES PRODUCTION¹

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Abstract. Twelve or more conifer species are well suited for Christmas tree production in New Mexico. Native conifers and a few exotics form an outstanding array from which selections can be made. A grower's choice should be derived from two considerations: consumer appeal and grower appeal, each determined by several factors. A provisional tree hardiness zone map is proposed to assist growers' efforts to properly match species to the state's diverse regions.

Two factors must be considered when selecting tree species for Christmas tree production: consumer appeal and grower appeal. The market appeal of a given species will vary somewhat with geographic region, but the attributes considered desirable are rather constant, if not concrete. Generally, the consumer wants a 6-8 ft. tree with a compact, symmetrical crown that is suitably tapered. The needles should be of uniform, acceptable length. Foliage should be uniformly dense, deep green to silvery blue, soft and fragrant. Most importantly, needles should be fresh so they are retained under warm, dry conditions.

Obviously, not all species marketed for Christmas trees possess all of these attributes. However, these attributes collectively outline the Christmas tree ideotype. In most cases, a purchased tree will reflect the best compromise among several factors, including local availability and price as well as tree attributes.

The grower's decision to produce trees of a given species reflects a compromise among crop attributes, market demand and the ability of accessible land to produce quality trees. Clearly, the growth rate of a given species should be acceptable, and the cultural steps necessary to achieve satisfactory growth and quality must be affordable. Species should be avoided that are highly susceptible to environmental stress, or require elaborate soil or pest

¹ Paper presented at the 2nd Afghan Pine and Christmas Tree Conference, Sept. 30- Oct 1, 1986, New Mexico State University .

management techniques. Species should be chosen that provide acceptable and predictable tree quality, size uniformity, market opportunities and profits.

Site plays a major role in crop success and profitability. Clearly, the most sophisticated approach to plantation management will not drastically alter the influences of climate and soils on crop survival and growth. Climatic factors of major importance include absolute maximum and minimum temperatures, the number of frost-free-days, precipitation, radiation load and wind. High wind and radiation can intensify moisture and cold stress, resulting in tree mortality or crown deformity. Tree crowns become misshapen when cold, desiccating winds kill exposed buds.

Precipitation effectiveness is of major importance because it identifies the need to irrigate crops when evaporative demand exceeds nature's supply. Trees can be grown in mountain valleys with minimal irrigation, but supplemental water is essential at lower elevations. Soil drainage, texture, pH and salts are also potentially limiting. The impact of these and other soil factors on land suitability for tree planting is evident in Table 1.

Table 1. Soil groups defined for Christmas tree production.

1. Deep (at least 3 ft. of soil) loamy, well drained soils highly suited to plantation production.
2. Loamy soils with high water tables, or subject to frequent flooding. Drainage required for plantation production.
3. Loamy or clay loam surface layers with gravelly subsoils. Unsited for live tree production.
4. Coarse textured soils requiring frequent irrigation. Unsited for live tree production.
5. Clayey, imperfectly drained soils unsited to conifers intolerant to low soil oxygen.
6. Saline or sodic soils (pH above 7.8). Limited to species tolerant of high soluble calcium levels and moderate salt levels.

Numerous conifer species are potentially plantable in New Mexico because of the diverse climatic conditions found in the state. For a specific area, the site factors discussed should be explored, in addition to publications addressing species attributes. The USDA Hardiness Zone Map broadly defines zones based upon maximum and minimum temperature isolines. The map is useful but inadequately defines the diverse climatic conditions found in the mountainous western states. Therefore, we propose a supplemental map with zones established by frost-free days, indicated by 20-day isolines (Fig. 1).

The map proposed is provisional in that zones recommended for individual species can be revised as the information base expands. We believe the map will be useful for several reasons: Zones are based upon a climatic parameter that shows high correlation with the more complex and theoretically better fortified methods of temperature evaluation (e.g., temperature efficiency indices); Planting windows can be prescribed for each zone after systematic tests; Zones should be useful in prescribing pest control procedures because pest maturation cycles are influenced by temperature sums correlated with frost-free days.

Christmas Tree Genera

In selecting species, it is helpful to recognize a simple principle: Species within a genus are more similar in their site requirements than are species of different genera. This statement is supported by the occurrence of a given genus in environmentally similar habitats throughout the world. The second principle of importance is that some genera are more genetically diverse, evidenced by their comparatively large numbers of wide-spread species. This explains why the genus Pinus can be planted over a wider range of site conditions than less genetically diverse genera (e.g., Picea and Abies). Table 2 compares the soil demands of the conifer genera important to the Christmas tree industry. Table 3 lists individual species believed potentially plantable in New Mexico and, in addition to tree zone recommendations, and species attributes.

Abies (True Firs)

The true firs are widely scattered through the forests of North and Central America, Europe, Asia and North Africa. They grow in cool temperate regions and mountains. Several

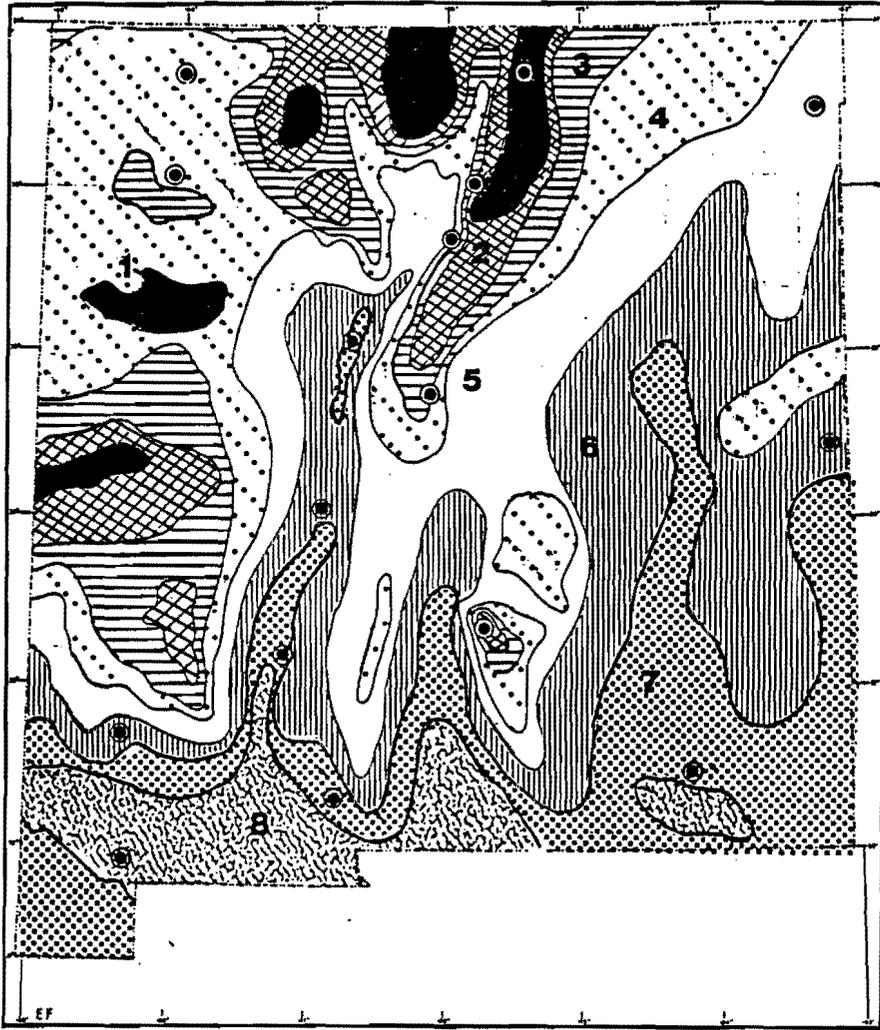


Figure 1. New Mexico provisional tree zone map. Frost-free days for each zone are: Z1 = less than 100, Z2 = 100-120, Z3 = 120-140, Z4 = 140-160, Z5 = 160-180, Z6 = 180-200, Z7 = 200-220, and Z8 = more than 220. Frost-free days were obtained from Tuan et al. (1969).

Table 2. Soil demands among Christmas tree genera

	Fertility Requirement	Acceptable Soil pH ¹ (Ac/N/Alk)	Moisture Tolerance ----- Deficit/ Excess		Soil Groups ²
<u>Abies</u>	M	Ac-N	L	M	1,3
<u>Pseudotsuga</u>	M-L	Ac-N	M	L-M	1,3
<u>Picea</u>	M-H	N	L-M	H	1,2,3,5
<u>Pinus</u>	L-M	Ac-Alk	M-H	L-M	1,3,4,6
<u>Cupressus</u>	L	N-Alk	H	L	1,3,4,6
<u>Juniperus</u>	L	N-Alk	H	L	1,3,4,6

¹ Ac = pH \leq 6.5, N = 6.5 - 7.5 and Alk = \geq 7.5.

² At least one species of the listed in Table 3 is adapted to each soil group listed after each genus.

species have excellent Christmas tree properties, including compact crown, soft fragrant foliage, and favorable shearing response. Shipping qualities and needle retention are very good to excellent (Table 4).

A. concolor. White fir occurs naturally from northern Oregon, southward through the mountains of California, New Mexico, southern Colorado, and Arizona into northern Mexico. It is the most popular Christmas tree species in the western states. Its fragrant, silvery-blue needles (1.5 to 2.5 inches) curve upwards along the twigs. White fir will produce a premium Christmas tree in nine or more years. Improper culture or seed source will slow growth considerably. White fir is susceptible to late spring frost and, therefore, should be planted on sites with good air drainage. Branch buds are sensitive to winter desiccating wind, common to open exposures at high elevations.

West Coast sources are not winter hardy in New Mexico. Rocky Mountain white fir is generally bluer than west coast sources. Although some southern New Mexico white fir are much greener than southern Colorado sources, extremely glaucous specimens can be found in north central New Mexico. Zones 2-6.

A. lasiocarpa. Corkbark fir is native to the southern Rocky Mountains and trees are harvested from native stands. It

is not recommended for plantation production because its form and growth are much inferior to white fir.

A. balsamea. Balsam fir has excellent Christmas tree properties but is not being grown in New Mexico. Northern growers have cited low soil moisture as a major factor in survival and growth. Their reports also indicate it is generally difficult to establish and is susceptible to winterburn and late spring frosts. This species deserves research attention because it would add diversity to the regional industry. It is probable that it will be successful only where irrigation water is reliably available and the risk of winterburn is low. Zones 2-4.

Table 3. Appeal, recommended tree zone, and plantation rotation (yrs) for each of fifteen species potentially plantable for New Mexico Christmas trees.

Species	Appeal		Tree Zone (NM Prov.)	Rotation
	----- Consumer / Grower			
<u>Abies</u>				
<u>concolor</u>	H	L-M	2-6	8-10
<u>balsamea</u>	H	?	2-4	"
<u>nordmanniana</u>	M	?	4-6	"
<u>magnifica</u>	H	L-M	"	"
<u>Pseudotsuga</u>				
<u>menziesii</u>	M	L-M	2-5	"
<u>Picea</u>				
<u>pungens</u>	M	M-H	1-6	7-9
<u>glauca</u>	L-M	"	"	9-12
<u>abies</u>	"	"	"	10-12
<u>Pinus</u>				
<u>sylvestris</u>	M-H	H	2-6	4-7
<u>brutia</u> subsp.				
<u>eldarica</u>	L-M	H	7-8	2-4
<u>nigra</u>	L	H	3-6	5-7
<u>contorta</u>	L	L-M	2-6	4-7
<u>strobiformis</u>	M-H	M-H	2-6	5-7
<u>edulis</u>	M-H	L	3-8	10-12
<u>cembra</u>	M-H	L	2-6	10-12
<u>Cupressus</u>				
<u>arizonica</u>	L	M-H	5-8	4-5
<u>Juniperus</u>				
<u>scopulorum</u>	L	M	4-8	7-9
<u>virginiana</u>	L	M	3-8	7-9

A. nordmanniana. Caucasian fir is native to the mountain regions of the West Caucasus. Juvenile trees have straight stems and narrow pyramidal crowns. Leaves are dark

Table 4. Properties of Christmas tree species grown in Michigan (Adapted from Koelling and Wright (1978)).

Species	Fragrance	Color	Twig Flexibility	Needle Retention	Shipping Qualities
<u>Abies</u>					
<u>concolor</u>	VG	VG	G	VG	E
<u>balsamea</u>	VG	VG	F	VG	E
<u>Pseudotsuga</u>					
<u>menziesii</u>	VG	E	F	VG	E
<u>Picea</u>					
<u>pungens</u>	G	E	E	G	F
<u>glauca</u>	P	VG	VG	F	G
<u>abies</u>	G	G	G	P	VG
<u>Pinus</u>					
<u>sylvestris</u>	G	P-E	E	E	G
<u>nigra</u>	G	VG	E	E	VP
<u>strobiformis</u>	E	E	G	E	G

P = poor, F = fair, G = good, VG = very good and E = excellent.

green. This species is not grown in the region, possibly because viable seed is difficult to obtain. It deserves attention because among true firs it is above average in tolerance to heat and soil calcium. Zones 4-6.

A. magnifica. California red fir occurs naturally in the mountains of California and Oregon. Its needles are shorter than white fir. Red fir is not currently grown in New Mexico but deserves attention because of its attractive blue green foliage. Its elevational limits will probably be below white fir. According to Forest Service researchers, seed sources of the eastern Sierras may be better adapted to aridity. Zones 4-6.

Pseudotsuga

P. menziessii. Douglas-fir possesses most of the attributes of the Christmas tree ideotype (Table 4). Needle retention and shearing response are good. Douglas-fir is by far the most favored species in the Pacific Northwest.

Arizona and New Mexico seed sources of Douglas-fir are the bluest available to growers. Zones 2-5.

Picea (Spruces)

Spruces are native to cool parts of the northern hemisphere. The species are much less distinct than in the pines (Wright 1976). Spruce needles are short, rarely exceeding more than one inch in

length. Spruces grow more slowly than pines but are more symmetrical and therefore require less shearing. Needle retention is generally not as good as for pines, although several species have particularly attractive foliage and aroma. Needle retention varies among species (Table 4), but all spruces drop their needles if allowed to dry excessively. Spruces should be marketed close to production areas so they can be sold fresh.

P. pungens. Blue spruce is native only to the central Rocky Mountain states. In the southern Rocky Mountains, blue spruce grows singly or in small groups along the banks of streams, or on moist loamy soils of canyons and mountain valleys.

Blue spruce has gained popularity as a Christmas tree in recent years. Its crown is naturally symmetrical and is comprised of sharp-pointed needles, 1 to 1.5 inches. Foliage color is variable among trees, ranging from green to silvery blue. Color is determined by the quantity and physical structure of wax deposited on the needle surface. Genetic variation in foliage color within a plantation is striking and appears to increase with age (Hanover, 1975). It is not well suited to long distance transportation because its stiff foliage and rigid branching habit increase bulkiness. Among the spruces, blue spruce needle retention is best .

Jones and Bernard (1977) reviewed the genetic and ecological distinctness of Southwestern spruces. They explained how to distinguish Engelmann and blue spruces by crown shape, branch angle, bark and foliage. This information is useful to growers collecting their seed.

One can not generalize about the best states and regions from which to collect blue spruce seed because wide variation in color and height growth has been shown among progenies from different states and areas within the same state. Zones 1-6.

P. glauca. White spruce is found in the northern latitudes of North America. It will grow on sandy soil, but does best on well-drained loam. White spruce grows more slowly than Norway spruce , usually requiring 9-12 years. It has good form and color and requires minimal shearing. Needle retention is poor. 'Spartan spruce', a blue spruce X white spruce hybrid recently released by Michigan State University shows promise. Zones 1-6.

P. abies. Norway spruce was imported from Europe and is best suited to a cool, moist climate. It grows well on a variety of soil types. It tends to have a coarser and heavier main stem than white spruce. Needles are dark green ranging in length from .75 to 1 inch. Because cut trees retain their needles poorly, chemical sprays are sometimes used to promote retention. Growth varies greatly from site to site and 10-12 years may be required to produce salable trees. Slow growth tends to occur during the first few years after outplanting. An overall coarse appearance of the tree makes this species less desirable than either blue or white spruce. Norway spruce is not generally recommended for commercial Christmas tree plantations. Zones 1-6.

P. engelmannii. Engelmann spruce is wide spread throughout the mountains of the western states and sometimes is harvested from the wild for Christmas trees. It is not recommended for plantation production because its form is inferior to blue spruce.

Pinus

Native pine species are widely distributed in the northern hemisphere. Pines are the fastest growing Christmas trees, but were rarely grown as Christmas trees more than 40 years ago. Their juvenile crowns are less dense than spruces or true firs, but shearing generally improves their appearance.

P. sylvestris. Scots pine naturally occupies an enormous area reaching from Scotland and Scandinavia to northern Mongolia. Among pines, Scots pine is the most widely grown for Christmas trees. It is especially popular in northeastern states, eastern provinces of Canada, and on the Pacific Coast. It grows well on a variety of soil types, but is particularly suited to sandy soils. Considerable variation exists among geographic seed sources (provenances) in foliage color, needle length, growth rate and stem straightness. Zones 2-6.

P. brutia subsp. eldarica (= P. eldarica Medw.) naturally occurs only in the Caucasus Mountains of southern Russia. It is grouped with the few pine species able to grow on calcareous soils with pH values above 7.8. Afghan pine, or eldarica pine, is the fastest growing Christmas tree in North America. Marketable trees can be grown in 2-4 years, depending upon planting time, site and culture. Its fast growth is attributed to the production of numerous, evenly spaced whorls of growth during each growing season. Multiple flushes are particularly evident after establishment. At present, tree farmers are most concerned with cut-tree quality and tree-to-tree size variation. Work is needed to develop a full understanding of shearing response and storageability. Zones 7-8.

P. nigra. Austrian pine is native to Europe. It grows well on loamy to heavy soils and appears to be more tolerant to alkaline soil conditions than most pines. Its dark green needles are objectionably long and rather stiff. However, needles are strongly attached and are retained well under warm, dry conditions. Shipping quality is not good because branches tend to be stiff and brittle (Table 4). Austrian pine is especially suited to flocking due to its strong branching habit. Austrian pine Christmas trees are grown on a relatively small scale.

Seed sources in northern latitudes or upper elevations of its natural range are thought to be more winter hardy. A hybrid between Austrian and Japanese red pine (P. densiflora) shows promise because the objectionable features of Austrian are mostly absent. Some individuals have excellent form and color, but work is needed to achieve greater uniformity. Zones 3-6.

P. flexilis complex. The complex is composed of two populations of 5-leaved pines of the subgenus Haploxylon. The northern population has a range from southern Alberta and British Columbia south to north-central New Mexico. This population is universally known as P. flexilis. Members of the southern population occur in northern Mexico, Texas, Arizona, New Mexico and southern Colorado. The names most frequently associated with the southern taxon are: P. strobiformis Engelm., P. flexilis var. reflexa Engelm., P. reflexa Engelm., and P. ayacahuite var. brachyptera Shaw.

P. strobiformis is recommended over P. flexilis for plantation production because it grows faster. P. strobiformis is one of the bluest of the white pines. Its soft, densely arranged needles on all branches are retained three years. It is more widely planted now than a decade ago because of better seed availability and greater knowledge of its attributes. Zones 2-6.

Several white pine species can be crossed to produce vigorous F₁ offspring (Wright 1976). Superior hybrid planting stock may become available over the next decade.

P. edulis. Occurs naturally from southern Wyoming, western Texas and northern Mexico but is most conspicuous in the Four Corner states: New Mexico, Arizona, Colorado and Utah. Pinyon Christmas trees are generally harvested from natural stands. Under plantation conditions trees will be harvestable in 10 to 12 years. Pinyon is one of the most popular trees marketed in the Santa Fe, New Mexico area. Zones 3-8.

P. cembra. Swiss stone pine occurs naturally in the high mountains of southern Europe, from the Alps to the Carpathians. Its conical crown is unusually dense because needles are retained about five years. Its growth rate is similar to pinyon but its appearance is superior. It is not presently planted in New Mexico but should be more cold hardy than pinyon in mountain valleys at high elevations. This species deserves greater attention, particularly as a live Christmas tree, because its proportions and growth are ideally suited to garden plantings. Zones 2-6.

P. contorta. In the Rocky Mountains, lodgepole pine occupies a high-elevation zone just below the spruce-fir belt. Its natural range falls short of the northern New Mexico border. Lodgepole pine's growth rate is comparable to Scots pine but its density is inferior and is not markedly improved by shearing. However, it is marketable, evidenced by the sale of forest-cut trees in Colorado. It deserves attention because it is cold hardy to the upper elevational limits of New Mexico plantation production. Zones 2-6.

Cupressus

C. arizonica. Arizona cypress occurs naturally in Arizona and western New Mexico and grows on relatively dry, infertile soils. It resembles eastern red cedar, but its foliage

is bluer and its needles are less pointed. Its natural form is too columnar, but this can be corrected easily by frequent shearing. Christmas trees have been grown in the southeastern states but cut-tree foliage properties have lowered grower expectations over the past decade and the tree has lost popularity. Under optimal conditions, Christmas trees can be grown in 4 years. Probably a better choice than junipers for low elevational plantings, and a better choice than Afghan pine on sandy, droughty, soils. Zones 5-8.

Juniperus

J. scopulorum. Rocky Mountain juniper is native to the mountain regions of western North America. It is adapted to a wide array of soil conditions and is moderately tolerant of drought and salt. This species and eastern red cedar are moderate to slow growers, requiring up to 9 years to reach saleable size. Compared to eastern red cedar, Rocky Mountain juniper's blue green foliage is more attractive and its cold hardiness is superior. This species should be considered for problem sites where most species would fail. Zones 3-8.

J. virginiana. Eastern red cedar occurs naturally in nearly all the states east of the Great Plains. It has sharp, stiff needles which tend to develop a purple bronze color about harvest time in colder western climates. Hence, trees are generally cut and sold locally. It grows under a wide variety of soils, including well-drained, alkaline soils. For this reason, it is among the few species that can be grown on alkaline soils at New Mexico's lower elevations. This species is marketed in southeastern states. Zones 4-8.

Seed Source Variation Among Rocky Mountain Species

The importance of seed source selection among Rocky Mountain conifers is supported by numerous publications, including: Hanover (1975 & 1978), Doughty et al. (1975), Fisher and Davault (1978), Heit (1969), Wright et al. (1970 & 1971), Hamrick and Libby (1972), Kung and Wright (1972), Read and Sprackling (1976), Steinhoff (1964), Steinhoff and Andresen (1971), Steiner and Wright (1975), and Wright (1976).

The distribution of tree species between Arizona-New Mexico and Utah-Colorado is broken by expansive, arid grasslands. This geographic isolation has created distinct races in some species because the Arizona-New Mexico and Utah-Colorado tree populations do not interbreed (Kung and Wright 1972; Steinhoff and Andresen, 1971). This is supported by provenance tests conducted in Michigan, Nebraska, and Pennsylvania which identified several Christmas tree traits strongly influenced by seed source. For white fir, Douglas-fir, and the limber-southwestern white pine complex, several trends emerge when Utah-Colorado trees are compared with Arizona-New Mexico trees. Overall, the Arizona-New

Mexico trees grow 50 to 100% faster, are less winter hardy (not a serious problem on white fir or southwestern white pine), have longer needles, and with the exception of white fir have bluer or grayer foliage. Adoption of the faster growing provenances has led to 50 % reductions in Christmas tree rotations. Because growth, color and form of southern New Mexico and Arizona sources have been similar in eastern provenance studies, division of the two populations into races is arbitrary and largely unsubstantiated (Kung and Wright 1972).

In summary, at least twelve species can be grown for Christmas trees in New Mexico. Among these are several native species that can compete well in any market. Some of the species discussed, particularly the firs, can not be planted with confidence because they have not been adequately tested.

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