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Identification of Characteristic Traits of Two Varieties of Arizona Cypress

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Summary

Native trees and controlled plantings of two varieties of Arizona cypress were studied to identify morphological characteristics which are useful in classification of the varieties. Arizona cypress (*Cupressus arizonica* var. *arizonica*) and Smooth Cypress (*Cupressus arizonica* var. *glabra*) were studied both on an experimental planting in Alabama and in the wild in Arizona.

The two varieties were distinguishable primarily by bark texture and foliage resin gland occurrence. Other morphological traits appear to be affected to such a degree by the environment that they are not useful as classification variables.

Key words: Arizona cypress (*Cupressus arizonica* GREENE), morphology, breeding, variability.

Zusammenfassung

Es wurden autochthone Einzelbäume und kontrollierte Pflanzungen von 2 Varietäten von *Cupressus arizonica* untersucht, um morphologische Merkmale für eine brauchbare Klassifikation der Varietäten zu finden. *Cupressus arizonica* var. *arizonica* und *Cupressus arizonica* var. *glabra* wurden beide in einer Versuchspflanzung und am natürlichen Standort Arizonas untersucht. Die zwei Variatäten waren in erster Linie anhand ihrer Rindentextur und dem Auftreten von Blattharzdrüsen zu unterscheiden. Andere morphologische Merkmale scheinen in einem solchen Maße von der Umwelt beieinflußt zu sein, daß sie nicht als Unterscheidungsmerkmal zu benutzen waren.

Introduction

Arizona cypress (*Cupressus arizonica* GREENE) is a coniferous species indigenous to the southwestern United

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States and parts of northern Mexico and is potentially useful as either a Christmas tree or ornamental. Its native range is divided into several distinct geographical regions each containing a characteristic variety of the species. LITTLE (1979) listed the two taxa occurring in the eastern part of the range as varieties:
Cupressus arizonica GREENE var. *arizonica* (typical) and *C. arizonica* var. *glabra* (SUDW.) LITTLE. In the United States *Cupressus arizonica* var. *arizonica* is found mainly in southeastern Arizona and *C. arizonica* var. *glabra* in central Arizona.

GREENE (1882), SUDWORTH (1910), SARGENT (1922), and KEARNEY and PEEBLES (1942) found the following traits to be representative of the two varieties:

Trait	var.*arizonica*	var. *glabra*
bark texture	fibrous	thin, exfoliating
bark color	dark red	purple-red
branches	horizontal	ascending
leaves	glaucous	with resin pits

POSEY and GOGGANS (1967) and GOGGANS and POSEY (1968) studied the overall morphological characteristics of the species. They collected cones from individual trees in Arizona, Texas, and northwest Mexico for use in heritability studies. Limb angle and stiffness, crown shape, bark texture and foliage traits were found to vary throughout the species' range. SCHOENIKE *et al.* (1975) collected cone and foliage samples during a trip roughly paralleling that of POSEY and GOGGANS. Collected seeds were used in a study of effects of variety and seed source on field survival in South Carolina. They found a significantly higher field survival in *C. arizonica* var. *arizonica* than in var. *glabra* An assessment of the gene resources of *C. arizonica* in the United States was published by SCHOENIKE in 1977.

Multiple stems, foliage and stem resin exudation and poor nursery survival have contributed to the poor success of early production ventures. If these problems are associated with specific varieties, then selection of seed sources with respect to variety is essential for successful nursery production. This study was made in an attempt to identify specific morphological features of the two varieties that could be used for classification of trees whose variety is unknown.

Methodology

A detailed examination of the morphological characteristics of *C. arizonica* was made for both var. *glabra* and var. *arizonica.* Foliage and cone samples were collected by SCHOENIKE *et al.* (1975). Samples of var. *glabra* trees were collected from fourteen seed source locations in central Arizona and samples of var. *arizonica* trees were collected from nine seed source locations in southeastern Arizona and two in southwestern Texas. Samples were collected from several trees (the number of trees ranged from 9 to 25 depending on stand size) at each location and were mounted on labeled herbarium sheets. Pertinent information regarding bark color, bark texture, crown shape, and foliage color of each sample tree was recorded at the collection sites. The degree of resin gland occurence of each seed source was estimated by examination of mounted foliage sprays.

A plantation of Arizona cypress of known seed source was sampled in Alabama in 1976. The plantation contained two plantings made by GOGGANS *et al.* in 1966 and 1964 with seed collected by POSEY and GOGGANS (1967). The plantation site was a flat, moderately drained bottomland located near Tuskegee, Alabama. Soils ranged from sandy loam to fine sandy loam. The plantation was located in a frost pocket and subject to flooding during heavy rainstorms. Variety *arizonica* and var. *glabra* were represented by seven seed sources and two seed sources respectively. Each seed source was represented by at least 12 mother trees. One row of trees from each seed source occurred in each of four replicates in each planting. The number of trees per seed source at the time of sampling varied due to mortality. Foliage samples were collected from two trees per seed source in each replicate in each planting. A total of 130 foliage samples were collected. Only a few trees were producing cones at the time of the sampling so cones were not collected. Description of bark, foliage, and crown characteristics were recorded for each sample tree. Bark, foliage, and crown characteristics were measured as discrete variables and were examined for homogeneity of frequency distributions and tested with chi-square procedures.

A series of classification schemes were formulated based on the results of the chi-square analyses on traits of trees grown in Alabama. These trees served as the basis for the classification criteria because both varieties were growing on the same site thus minimizing variation due to environmental differences. Characteristics which were found to have large intervariety variation and small intravariety variation were used as classification variables. The classification variables were used to prepare an "average tree" description for each variety. Trees grown in Arizona were then reclassified on the basis of the "average tree" descriptions. The "true" variety designation of the Arizona trees was based on their geographic location.

Each separate classification variable and all possible combinations of the variables were tested for their ability to correctly classify the Arizona trees. For schemes utilizing more than one classification variable, the traits were applied sequentially to each tree. A tree was classified as a given variety if it met the classification criteria of all of the classification variables in the scheme. Trees which failed to meet one or more of the classification criteria in a given scheme were counted as unclassified.

Results and Discussion

Bark color, bark texture, foliage resin gland occurrence, and crown shape showed large varietal differences when grown in a common environment. *(Table 1.)* Using these four characteristics, "average trees" were described as:

Trait	var. *arizonica*	var. *glabra*
bark texture	furrowed	smooth, peeling
bark color	gray to gray-brown	gray outer bark and greenish or reddish inner bark
foliage resin glands	few to plentiful	plentiful

These descriptions were roughly the same as those given by WOLF and WAGNER (1948). The Arizona trees were then reclassified based on these "average tree" descriptions. The results were as follows:

Characteristic	Proportion of trees correctly classified
	---- percent ----
bark texture	89
foliage resin gland occurrence	85
bark color	48
crown shape	29
bark texture and foliage resin gland occurrence	76

Table 1. — Analysis of homogeneity of frequency distributions for traits of Arizona cypress trees sampled in Alabama.

Source of Variation	Trait	Degrees of Freedom	Calculated chi-square value
Between varieties	bark color	4	24.37
	bark texture	2	89.41
	foliage resin gland occurrence	2	23.40
	crown shape	6	28.85
	foliage color	6	2.52
Among seed sources within var. *arizonica*	bark color	24	24.15
	bark texture	12	24.42
	foliage resin gland occurrence	12	14.83
	crown shape	36	25.33
	foliage color	36	31.73
Among seed sources within var. *glabra*	bark color	4	2.95
	bark texture	2	0.00
	foliage resin gland occurrence	2	.92
	crown shape	6	5.86
	foliage color	6	3.44

Bark texture and foliage resin gland occurrence were the only two characteristics which were satisfactory as classification variables, correctly classifying 89% and 85% of the trees, respectively. When used concurrently, they correctly classified 76% of the trees. Other single characteristics and combinations of characteristics were unsatisfactory as classifiers.

It can be concluded that trees of var. *arizonica* are identifiable by their furrowed bark and lack of resin glands on the foliage. Conversely, var. *glabra* trees will frequently have smooth bark and foliage dotted with resin glands.

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Growth of intra- and interprovenance families of Picea abies (L.) Karst.

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Summary

Data on tree growth from five field trials of interprovenance hybrids and parent provenances of *Picea abies* in central Sweden are presented. They belong to three series of trials established in 1958, 1966 and 1974, respectively. The mating design is factorial in all series, but many families are missing.

In two trials the variance components for GCA for tree growth characters were 3-10 times larger than for SCA. In one case they were of similar size and in trial No. 2 the ratio between the components GCA:SCA varied between 1.4 and 5.2. In the fifth trial no estimate of GCA or SCA was made owing to too many missing values. Strong significance for GCA was noted in three of the trials, but strong significance for SCA was only obtained in the second trial. Good general combiners were revealed in all but one of the provenances tested. Our data provide little or no support for a concept of general superiority of interprovenance hybrids.

A graphic technique to illustrate the stability of a family at two or more test sites is presented in *Figs. 4* and *5* and families superior at two test sites were distinguished.

Outstanding performance of some individual families was noted. The largest gains will be obtained by producing commercial seed of selected families.

Key words: Picea abies (L.) Karst., provenance hybrids, general combining ability (GCA), specific combining ability (SCA), genotype × environment interaction.

Zusammenfassung

In fünf Feldversuchen mit Provenienzhybriden von *Picea abies* (L.) Karst. in Zentralschweden wurden Baumhöhen und Volumenzuwachsmessungen durchgeführt. Die Versuche gehören zu drei verschiedenen Serien, die 1958, 1966 und 1974 gepflanzt wurden. Das Kreuzungsschema ist in allen Serien faktoriell, wobei jedoch viele Familien fehlen.

In zwei der Versuche waren die Varianzkomponenten für allgemeine Kombinationseignung (GCA) 3—10 Mal