SCOTS PINE PROVENANCES FOR NEW MEXICO CHRISTMAS TREE PRODUCTION

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ABSTRACT Thirty Scots pine sources of European origin were evaluated in northern New Mexico. Western European sources, especially those of French and Spanish origin exhibited desirable Christmas tree characteristics. Results indicate that under intensive plantation management, Scots pine can be produced on shorter rotations (possibly 7 years) than currently possible with native New Mexico conifers.

INTRODUCTION

The continuing development of New Mexico's Christmas tree industry has prompted an increasing interest in alternative species for plantation tree culture. Scots pine's (*Pinus sylvestris* L.) broad ecological adaptiveness and response to intensive plantation culture make it potentially the next most promising species for both central and southern New Mexico.

Considered to be the most widely distributed pine, Scots pine's natural habitat includes Scotland, Spain, France, Europe, the Scandanavian countries, northern Asia, U.S.S.R., Manchuria, Turkey and Greece. Its natural range includes regions with diverse climates where natural selection has created considerable genetic diversity within the species (Wright, 1976). Published reports have referenced natural populations at elevations of 100 meters in Sweden (Brown, 1969) to 2100 meters in Spain (Novak, 1953). Scots pine's adaptive amplitude is exemplified in its tolerance of both the hot summers of Southern Russia and the severe winters of Siberia. The breadth of the species eurythermic plasticity is evident in its ability to survive conditions ranging from long frosty winters with minimum temperatures of less than -50°C to long growing seasons with maximum temperatures approaching 40°C (Obminski, 1976).

Scots pine was introduced to the United States about 1650, and for the next 300 years was grown primarily as an ornamental, with occasional plantings for timber production (Wright, 1976). Accepted as a major Christmas tree species in the United States during the 1950's, Scots pine has since been widely planted in the Eastern and Lake States, the North Central and the Pacific Northwest. Research on the pine for its potential use as a Christmas tree began as early as 1953 when Dr. W. C. Bramble (then Professor of Forestry at Penn State) imported Scots pine seeds from native stands in Central Spain (Gerhold, 1985). Before the first evaluations could be made, commercial nurseries

began producing Spanish Scots pine soley based on the early performance of these trees.

The continued acceptance of the pine has led to extensive genetic evaluations and breeding programs generally aimed at localized Christmas tree industry development. Studies yielding characteristic differences between trees of different origins, resulting from genetic x environmental interactions, for the purpose of selecting desirable provenances and genotypes for a local area.

The results reported in this paper are based on a Scots pine provenance study conducted at NMSU's Mora Research Center (elevation 2,196 meters).

PROCEDURE

Seedlings of 30 origins were grown in Spencer-Lemaire 30 cubic inch "Root-Trainers" for nine months under greenhouse culture. Average height of the planting stock was 15 cm. Nine replications with ten-tree plots for each of the 30 origins were planted on 1.8 x 1.8 m spacing in April 1977. Supplemental irrigation was provided during the growing seasons with an overhead sprinkling system. Weeds were controlled both mechanically and by spot spraying with Atrizine. Double leaders were removed from trees during the first two growing seasons to maintain a single leader. Uniform shearing treatments were applied during the last five growing seasons.

RESULTS

Height

The fastest growing sources were from Austria (229,223,222), Belgium (218), France (213) and the USA (212), all of Central European origin. Similar results were reported in a provenance study conducted in Nebraska where Central European Scots pine sources were the fastest growers (Read, 1971). The fact that provenances of Austrian origin were not included in Read's (1971) study provides further evidence of the potential performance of Central European sources. The most southern (Turkey-208) and eastern (Spain-224, 226) European provenances exhibited the slowest growth.

Significant variation existed both within and between the geographic origins. The greatest variability per origin was observed in the Turkish provenances with percents of plantation mean ranging from 76 to 104 percent (Table 1). The poorest growers of the Turkish origin were the highest elevation (2,000m) and lowest elevation (950m) provenances (source 208 and 202 respectively).

TABLE 1. Seven year growth and needle characteristics of Pinus sylvestris L. origins in New Mexico (metric measurements).

Source	Country	Height		Stump Caliper	Basal Crown Width	Needle Length
		6-Year Height Meters	Percent of Plantation x Percent	cm	Meters	mm
205	Austria	1.52	101	7.4	0.90	48
222	Austria	1.67	111	8.1	1.00	54
223	Austria	1.69	111	8.0	1.00	60
229	Austria	1.88	125	8.7	1.10	58
218	Belgium	1.72	114	7.6	1.00	61
215	Bulgaria	1.58	104	8.2	0.91	51
220	England	1.52	101	6.8	0.83	56
203	France	1.50	100	7.1	0.88	52
207	France	1.37	90	7.0	0.76	47
210	France	1.37	91	7.3	0.77	54
213	France	1.70	113	9.1	1.01	59
219	France	1.41	94	6.9	0.83	47
221	France	1.54	103	7.2	0.88	49
204	Greece	1.56	103	8.1	0.92	52
216	Greece	1.51	100	7.9	0.88	49
225	Greece	1.49	99	8.0	0.87	47
230	Poland	1.40	93	6.4	0.78	50
214	Scotland	1.61	106	7.4	0.92	57
227	Scotland	1.56	104	7.4	0.88	53
217	Spain	1.46	97	7.8	0.81	51
224	Spain	1.27	84	7.0	0.75	48
226	Spain	1.15	76	6.6	0.70	44
201	Turkey	1.57	104	9.7	0.93	55
202	Turkey	1.34	89	7.7	0.81	52
206	Turkey	1.50	99	8.4	0.89	58
208	Turkey	1.15	76	6.8	0.67	55
209	Turkey	1.38	92	7.6	0.81	49
228	Turkey	1.54	102	8.6	0.94	52
211	USA	1.55	102	7.3	0.88	51
212	USA	1.71	114	8.2	0.98	56

Needle Color and Length

Beginning in October of each year, soon after the first frost, many of the Scots pine sources began to exhibit, progressively so over time, discoloration or yellowing of the foliage. The yellowing was most visible on the needle tips, continuing but usually to a lesser degree towards the basal portions of the needles. In general, the lower sides of the needles remained green, even on the sources with extensive yellowing. Trees on the perimeter of the plot and portions of the crowns on trees which were more exposed exhibited the greatest yellowing.

Because color is of major importance to Christmas tree growers, several studies have been undertaken to evaluate this phenomenon. Gerhold's (1959) review and work on discoloration of Scots pine provided the most conclusive rationale behind the winter yellowing process. Four factors were reported as having a combined effect on discoloration: A) high light intensities which bleach chlorophyll pigments; B) low temperatures that both retard chlorophyll formation and possibly exposes chlorophyll to decomposition; C) short photoperiods initiating dormancy which causes suppression of photosynthesis allowing photautoxidation of chlorophyll; and D) a differential response of Scots pine races to photoperiod.

Evaluation of the discoloration process in the Mora planting found that the Western European origins of intermediate growth

rates in general maintained the greenest color throughout the winter (Table 2). These results are in agreement with Cunningham's (1973) and Read's (1971) provenance color evaluations. Noteworthy is the fact that color readings were not stable until year four. Turkish sources 206 and 209 dropped from a green level for the first three winter seasons to a dull yellow color for the fourth through seventh winter seasons.

TABLE 2. Growth rate and winter needle color groupings of scots pine provenances after seven years.

	WINTER FOLIAGE COLOR		
HEIGHT GROWTH	Yellow	Yellow Green	Green
Fast 1.65 to 1.91 Meters/Year	229 Austria 223 Austria 218 Belgium 213 France 212 USA	222 Austria	
Intermediate 1.40 to 1.65 Meters/Year	215 Bulgaria 220 England 225 Greece 230 Poland 214 Scotland 206 Turkey 228 Turkey	205 Austria 207 France 219 France 204 Greece 216 Greece 227 Scotland 201 Turkey	203 France 221 France 217 Spain 211 USA
Slow 1.14 to 1.40 Meters/Year	202 Turkey 208 Turkey 209 Turkey	224 Spain	210 France 226 Spain

In general, all findings from the color evaluations corresponded well with other reports which included similar origins. However, all sources

listed as green had scores which fell on the paler end of the green scale. Evaluations of the climatic and edaphic information suggest that the Mora site represents harsh extremes in all variables which have a negative effect on winter color intensities. Local weather data for the year of evaluation is provided in Table 3 for comparison with other study locations and also for evaluation of potential planting sites. For information concerning climatic conditions in your area, consult with the State Climatologist, New Mexico Department of Agriculture, Las Cruces, New Mexico.

TABLE 3
REMOTE WEATHER STATION 1985 DATA SUMMARY*
MORA RESEARCH CENTER

	TEMPERATURE						WIND		SOLAR SOIL		
	MEAN		EXTREMES		DEWPNT	TOTAL	SPEED	DIREC	MAX	RAD	TEMP
MONTH	MAX	MIN	HIGH	LOW	TEMP	PRECIP	MEAN	MEAN			
JAN	41	11	57	-19	10	2.00	5.6	295	38.	10.5	34
FEB	46	15	61	-14	9	0.02	6.8	292	38.	15.0	35
MAR	52	23	66	4	15	3.28	7.8	269	45.	16.3	41
APR	61	32	75	15	22	3.38	7.2	278	36.	21.4	52
MAY	68	37	79	27	28	1.47	6.5	274	31.	23.8	61
JUN	78	45	88	39	37	1.94	5.8	269	22.	24.7	69
JUL	83	65	89	42	44	2.68	5.2	257	22.	21.3	70
AUG	81	48	89	42	44	2.81	5.1	267	25.	21.3	69
SEP	69	40	83	28	36	2.74	5.3	210	31.	17.9	63
OCT	63	34	74	21	30	2.57	5.9	275	36	15.0	53
NOV	53	25	67	4	15	0.26	7.6	273	36.	12.8	42
DEC	49	15	61	-8	8	0.16	6.7	299	40.	11.2	35
			TOTAL PRECIPITATION			23.31					

UNITS
Temperature - Degrees F
Precipitation - Inches
Windspeed - Mile/Hour
Solar Radiation - Megajoules/Sq Meter

*Data summary provided by State Climatologist/New Mexico Depart. of Agri.

Origin means for needle length (when correlated with height growth) ranged from 48 mm for the slowest growing origin to 61 mm for the fastest growing origin. This observed trend is supported by both Ruby's (1967) and Reads (1971) findings on needle length. However, of further consideration is the fact that intra-origin variation in needle length was significant for those origins with multiple provenance representatives. Therefore, one could possible gain some quality in crown density characteristics by selecting among provenances in origins for desirable needle lengths.

CONCLUSION

Based on initial evaluations, Scots pine looks promising as an alternative Christmas tree species. Results indicate that quality Christmas trees can be produced on shorter rotations (possibly 7 years) and on a larger geographic scale than is currently possible with native New Mexico conifers.

Selection of Western European sources, especially those of French and Spanish origin, should provide trees of acceptable growth rate and desirable winter foliage color. Results from other provenance studies make it reasonable to assume that planting this pine at lower evaluations (lower than the current test site) will enhance the winter color intensity of desirable provenances or varieties. In addition much work has been done in the improvement of commercially available Scots pine varieties since this study was initiated.

Scots pine requires intensive cultural management activities much the same as with Afghan pine. Three <u>potential advantages</u> of growing Scots pine along with Afghan pine are; A) reduction in labor intensive shearing activities, B) the potential of one to two years of hold over when markets are

depressed, C) product diversity with a species which is already well accepted on the Christmas tree market. The actual ability to intercrop the two species will be dependent upon specific climatic and edaphic conditions which would be favorable to both. Consult the Provisional Tree Zone Map (Fisher and Fancher, 1986) for matching optimum species production potential to selected sites.

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