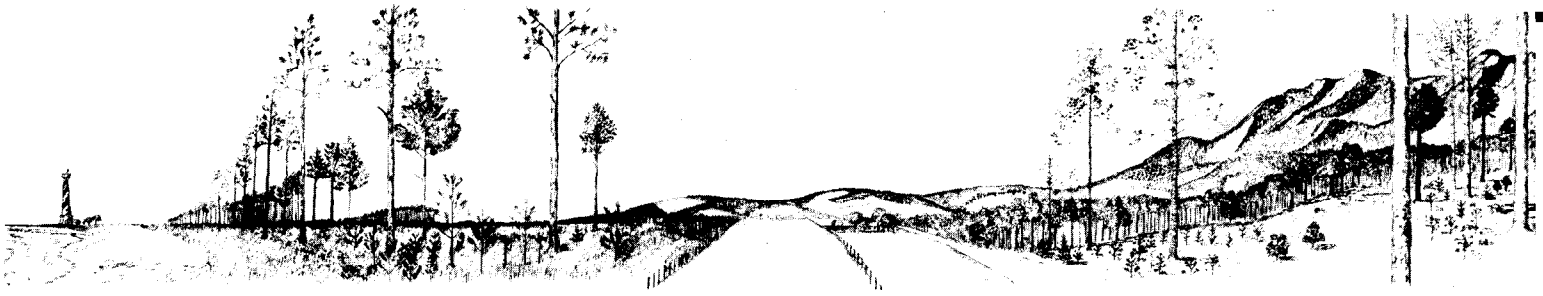

U.S. Department of Agriculture

forest Service Research Note SE-299 August 1980

CRYPTOMERIA DOES NOT SURVIVE IN THE UPPER COASTAL PLAIN OF GEORGIA

by Timothy La Farge [1]

ABSTRACT.-Nine seed sources of ***Cryptomeria japonica*** from the northern portion of its range in Japan were tested in the Upper Coastal Plain of central Georgia. Although these sources varied significantly in their rates of growth in the nursery, only 3 of 180 trees survived after 5 years in the field.

Keywords: ***Cryptomeria japonica,*** seed source, habitat.

A major disadvantage of the native southern pines in many areas of the southeast, especially of loblolly pine (***Pinus taeda*** L.) and slash pine (***P. elliottii*** Engelm.), is their susceptibility to fusiform rust (***Cronartium quercuum*** (Berk.) Miyabe ex Shirai f. sp. ***fusiforme***). Although several programs are underway to breed for rust resistance within these species, this method takes time. An alternative is to introduce exotic species of forest trees which are adapted to the local environments but are not susceptible to fusiform rust. Kraus (1963) investigated 67 species of forest trees by growing them in the Olustee Arboretum in Florida, but the primary interest was in naval stores production, not resistance to rust.

A horticultural variety of ***Cryptomeria japonica*** (L.F.) Don is occasionally planted as an ornamental in Georgia with good success. I have seen several of these fast-growing, vigorous trees which have no apparent disease problems.

A monotypic genus, cryptomeria (also called sugi) is a forest tree native to Japan and China. It has been cultivated for artificial afforestation for about 400 years (Toda 1974; Walters 1974). The wood is soft but strong and durable, and in Japan it is used for boxes, poles, and general construction (Walters 1974).

The natural range of cryptomeria is in a region with a climate that has similarities to that of Georgia. Many areas in that region receive the same annual rainfall as does central Georgia, but some areas receive as much as 55 inches more per year. Mean annual temperature is as much as 10°F cooler than in central Georgia, but the extremes are not so great (USDA 1941; Williams 1963; Good 1964). It was decided to test this species in central Georgia to determine if it would survive and perhaps make a suitable forest tree. The species' immunity from fusiform rust would be an advantage in Georgia.

This paper reports the results of a small provenance test established on the Upper Coastal Plain of Georgia.*

MATERIALS AND METHODS

In October 1971, seed from nine cryptomeria sources were received from Dr. Carl E. Ostrom, then Director of Timber Management Research, USDA Forest Service, Washington, D.C. Source information and climatic data are shown in table 1.

A germination test by the USDA Forest Service National Tree Seed Laboratory indicated

[1] La Farge is Plant Geneticist, Intensive Loblolly Pine Culture Resources and Development Program, Macon, Georgia 31208.

[2] Land and facilities donated by the Georgia Kraft Company and Georgia Forestry Commission are gratefuliy acknowledged.

Table 1—Origin and climatic data "i nine seed sources of cryptomeriain Japan and of the lest location in Georgia

Lot	Closest weather station	North lat.'	East long.	Elev	Precipitation				Temperature					Length of record	Nursery height
					Mm. month	Max month	Avg annual	% of total May-Aug.	Avg highest	Avg. lowest	Max	Min	MO.		
			° '	*Feet*		*Inches*					°*F*			*Years*	*cm*
SEED SOURCES OF CRYPTOMERIA															
Isomatsu	Hakodate[2] (Southern Hokkaido across strait)	41 48 (41 6)	140 42	109 (130)	2 3 Feb.	7.0 Sept	46 6	37	44 Jan. 86 Aug	6 Jan 55 Aug	92 51	48 - 7	Aug Jan	65	20 0abc[3]
Owani 2 3 5	Akita[2] (60 mi south of Owani)	39 42 (40 301	140 6 (141 30)	33 (920)	4.1 Feb	8.3 Sept	729	34	44 I eb 93 Aug.	9 Feb. 60 Aug	96 56	48 -12	Aug I eb	44	19.2 abc 22.0 ah 17.2 bc
Johoji	Akita[2] (30mi south of Johoji)	39 42 (40 12)	140 6 (141 0)	33 (1310)	41 Feb.	8.3 Sept.	72.9	34	44 Feb 93 Aug	9 I eb 60 Aug	96 56	48 -12	Aug Feb	44	19.4 abc
Yamanokami	Akita[2] (90mi NE of Yamanokami)	39 42 (39 0)	140 6 (141 0)	33 (1120)	4.1 teb.	8.3 Sept	72.9	34	44 I eb 93 Aug	9 Feb. 60 Aug.	96 56	48 -12	Aug. Feb.	44	21.2 abc
Ohara	Miyako[2] (50mi north of Ohara)	39 36	142 0	98	2.6 Dec	9.5 Sept.	56 2	39	53 Feb 93 Aug	11 Jan 59 Aug.	99 65	49 I	Aug Jan.	44	13.4 d
Shiramine	Kanazawa[4] 125 mi north of Shiramine)	36 30	136 36	94	61 May	14.4 Dec.	99 64	28	July Avg 75.6	Jan. Avg 36.8	101	15		20	16.9 c
Shizuoka	Tokyo[2] (80mi NE of Shizuoka)	35 42	139 48	19	1.9 Jan	9.2 Sept	61 6	39	60 Jan 92 Aug	22 Jan 65 Aug	101 72	60 17	Aug. Jan.	60	22.4 a
TEST LOCATION IN GEORGIA															
Houston Co., Georgia	Hawkinsville, Georgia[4]	37 18	83 30	245	2.3 NOV.	5.4 July	46.1	39	July Avg 81.6	Jan. Avg 49.2	110	-3		40	

[1] Latitudes, longitudes, and elevations in parentheses are those of the sources themselves.
[2] Meteorological Office. 1966. Tables of temperature, relative humidity and precipitation for the world (Asia) Part V. London (Met. 0 617e). Cited after Dr. Ralph A. Read (retired), *Forestry Sciences* Laboratory, Lincoln, Nebr., personal communication, October 11, 1979.
[3] Means not followed by the same letter are significantly different at the 0.05 level
[4] U S. Department of Agriculture (1941).

an average germination of 18.7 percent for all nine lots. The seed were sown in the greenhouse on February 10, 1972, each seed lot to a separate flat. The resulting seedlings were transplanted to nursery beds with two replicates on April 12 and two on April 19. Approximately 2,800 seedlings were planted in the nursery, but only 329 (12 percent) of these still survived when their heights were measured on September 25, 1972.

The seedlings were lifted on February 20, 1973, and hand planted (grub-hoe method) on February 21 in Houston County, Georgia. The soil in this area belongs to the Greenville-Magnolia-Faceville association (Perkins and Ritchie 1965). The surface soil layer is a coarse loam and is underlain by a clayey subsoil. The aspect is easterly, and the slope does not exceed 3 percent.

The, field was plowed and disked before planting. The area planted was a portion of a larger field formerly planted mostly to peanuts. No herbicide or other method of vegetation control was used before or after planting. This was the same procedure we use to establish southern pine progeny test plantations. The planting was arranged in a randomized complete-block design with four replications and five-tree row plots. Plot size and replication number were limited by the small numbers of seedlings (19 and 2 1) remaining in two seed lots (Owani 5 and Yamanokami). A commercial loblolly seed lot was used as a control.

RESULTS AND DISCUSSION

Heights were measured in the nursery, but there was little opportunity for anything other than observations of the trees in the field.

Nursery *Phase*

In the nursery, differences in height between sources were highly significant, as indicated by the tabulation of mean squares:

Source of variation	Degrees of freedom	Mean squares
Between sources	8	323.70**
Within sources	320	30.39

A student-Newman-Keuls multiple range test, based on unequal sample sizes (Sokal and Rohlf 1969) was applied to the data (table 1). Since the heights are not correlated with climatic or altitudinal data, the only conclusion that can be drawn from the differences in nursery height among sources is that they suggest stand-to-stand variation. One reason that seed source may not reflect adaptation of cryptomeria to environmental variables is that for three decades in the late 19th century, public and private landowners ignored seed source when establishing new stands (Toda 1974). Since the first decade of this century, increasingly careful attention has been given to genetic quality. However, the kinds of selection and breeding practices may not produce trees that reflect adaptations to their place of origin. Also, the original place of origin may have long since been forgotten.

Field Phase

It was originally intended that the trees be measured at the end of the 3rd year in the field, at which time they were expected to.have resumed growth after recovery from planting shock. However, they did not survive this long, and, even after the first growing season, most of the seedlings looked chlorotic and some had already begun to turn brown.

By the end of the second growing season, approximately half of the trees had died, and those remaining showed very little evidence of growth. In the following three growing seasons the seedlings continued to decline. They were finally plowed under in January 1978, when only three cryptomeria trees remained alive.

If seed representing a larger portion of the range had been sampled, it is possible that one or more seed sources might have been included which would have been adapted to the climate in central Georgia. However, despite similarities in the ranges of seasonal temperature and precipitation variations between Japan and Georgia, there are some differences. At the northern end of Honshu, the main island of Japan, where the annual precipitation is most similar to that in Georgia, the summer and winter temperature extremes are not so great as those in central Georgia. But in the southern and central portions of Honshu, where the temperature averages are also similar to those in the Upper Coastal Plain of Georgia, the rainfall is greatest, sometimes as much as 100 inches or more per- year. Growth rhythms could also be different. September and October are usually very dry months in Georgia, whereas in Japan those months are frequently quite wet.

These negative results were anticipated by at least one scientist. Professor Haruyoshi Saho of the University of Tokyo stated that "... it is too dry for *Cryptomeria* in Georgia."[3] Although the results of this test in central Georgia appear to confirm Professor Saho's prediction, it is possible that cryptomeria may do well as a forest tree in the mountains of north Georgia and over much of the Southern Appalachians, at least at the middle and lower elevations. In that region the cooler and wetter climate is more like that in the mountains of Japan.

LITERATURE CITED

Good, Ronald
1964. The geography of the flowering plants. 518 p. Longmans, Greene and Co. Ltd., London.

Kraus, John F.
1963. The Olustee Arboretum: Performance of 67 species of forest trees. USDA For. Serv. Res. Pap. SE-4, 47 p. Southeast. For. Exp. Std., Asheville, N.C.

Perkins, H. F., and F. T. Ritchie
1965. Soil associations of Georgia. 1 map. Ga. Agric. Exp. Stn., Univ. Ga., Coll. Agric., in cooperation with USDA Soil Conver. Serv.

Sokal, Robert R., and F. James Rohlf
1969. Biometry. 776 p. W. H. Freeman and Co., San Francisco.

Toda, Ryookiti
1974. Notes on the Japanese State Government forest tree breeding project. *In* Forest tree breeding in the world, p. 161-169. R. Toda, ed. Ryookiti Toda, Pub., Meguro, Tokyo, Japan.

U.S. Department of Agriculture
1941. Climate and man. 1,248 p. U.S. Dep. Agric., Yearb. Agric. 1941.

Walters, Gerald A.
1974. *Cryptomeria japonica* (L. F.) Don. In Seeds of woody plants in the United States. U.S. Dep. Agric., Agric. Handb. 450, p. 361-362. U.S. Gov. Print. Off., Washington, D.C.

Williams, Joseph E., ed.
1963. Prentice-Hall world atlas. 2nd ed. 41 p. Prentice-Hall, Inc., Englewood Cliffs, N.J.

[3] "Personal communication. February 25, 1972

The Forest Service, U.S. Department of Agriculture, is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives-as directed by Congress-to provide increasingly greater service to a growing Nation.