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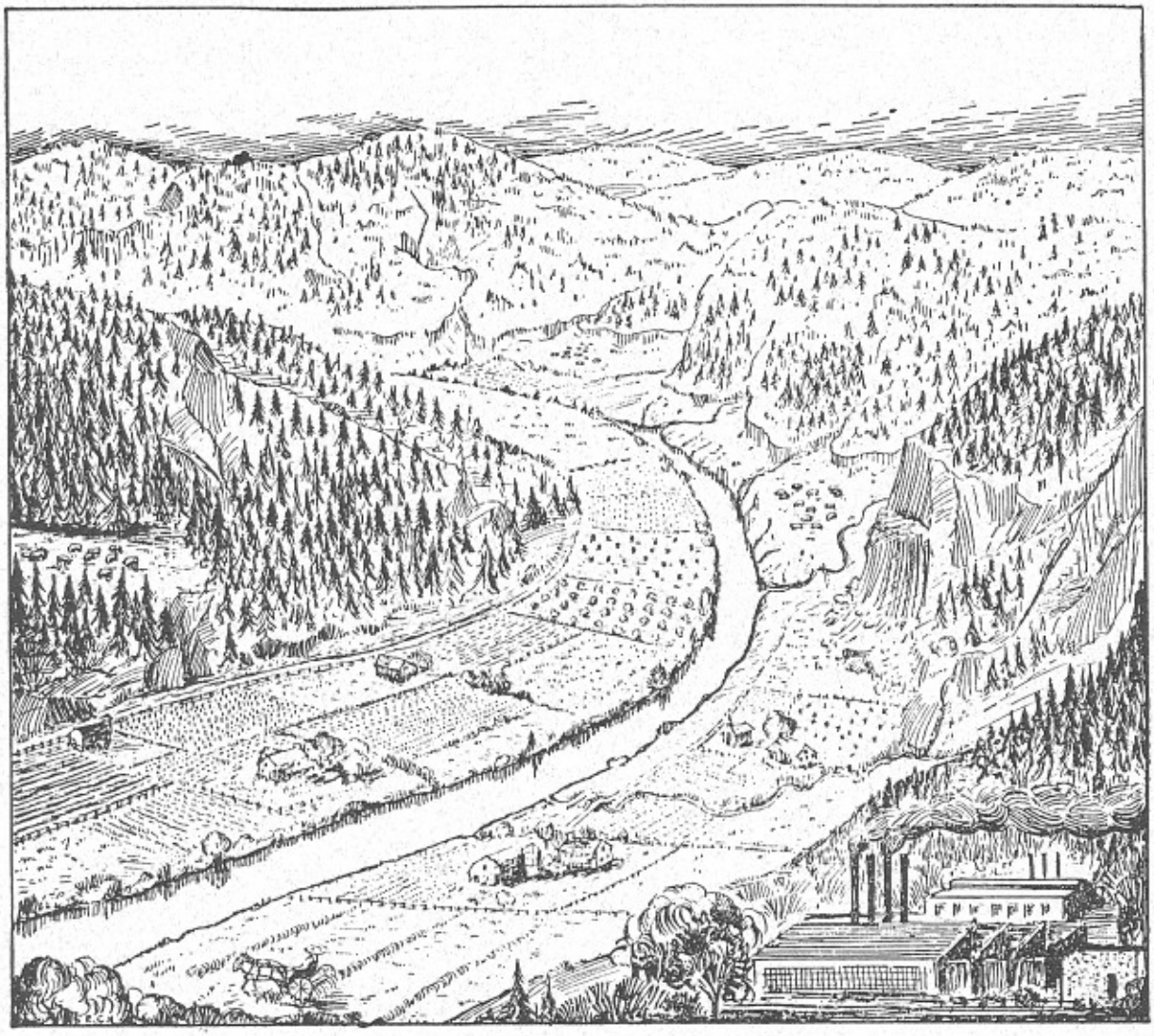
A Black Walnut Seed-Source-Elevation Study



By Thomas A. Dierauf and James W. Garner

VIRGINIA DEPARTMENT OF FORESTRY

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Abstract

A test was installed using 21 different seed sources collected within a hundred mile radius but ranging in altitude from 480 to 2400 feet. High altitude sources did not resist or avoid frost damage to leaders any better than low altitude sources. There was considerable height variation at age 9 among sources (from 6.9 to 10.4 feet), and height differences among sources were related to altitude, with height tending to decrease with increasing altitude.

Introduction

Young black walnut trees in Virginia frequently lose their leaders, making it difficult to develop straight boles, and necessitating considerable corrective pruning. One cause of leaders dying is cold damage by either late spring or early fall frosts. We wondered whether seed collected from high elevations might produce seedlings that would either resist frost damage or avoid it by leafing out later and hardening off earlier.

Procedure

Nuts were collected in the fall of 1970 from 21 stands of better-than-average quality located within 100 miles of Charlottesville, Virginia. Elevations ranged from 480 to 2400 feet above sea level. An attempt was made to collect at least 200 nuts in each stand, collecting from at least ten different trees. In two of the 21 stands, we were only able to collect 100 nuts. The nuts were sown on December 1, 1970 at the Augusta Nursery. The 200 nuts from each source (stand) were divided into five lots of 40 and sown in small plots in five randomized blocks in a single seed bed. Germination on June 18, 1971 ranged from 10% to 74% for the 21 sources, and the total number of one-year-old seedlings present on March 21, 1972 ranged from 18 to 140.

The seedlings were lifted on March 21 and equal numbers of seedlings were taken from each replication of each source for planting in the field. This meant taking nine seedlings (when available) from each seed bed plot to obtain the 45 seedlings from each source that were planted. The seedlings were planted on March 30, 1972 on the Lesesne State Forest at a spacing of 6.6 x 6.6 feet. Three randomized blocks were installed, with a 15 seedling row of each source in each block. For four of the 21 sources, there were not

enough seedlings for 15 seedling rows, and for these sources, shorter rows were planted.

The better seedlings (largest) were selected for planting, which could have favored the sources that had produced the most seedlings.

The planting site is a deep, rocky, colluvial soil developed from granodiorite, which is an excellent hardwood site. It is an old, abandoned field sloping gently to the south.

Herbicides (a mixture of Simazine and Paraquat) were used to control grass and weed competition in the spring of the year, starting when the seedlings were planted and continuing through the fourth season in the field.

Results

The 21 different stands from which seed was collected are listed in Table 1, in decreasing order according to average height at age 9. Up through age 9, we spent considerable time cutting grape vines, which were a serious problem, and cutting invading brush and hardwoods. After age 9, we discontinued this work and grape vines interfered with height growth of many trees. Consequently, no measurements were made after age 9.

Survival was excellent for all sources, and at age 9, overall average survival was 96 percent and ranged from 87 to 100 for the 21 sources.

We could not see any differences in amount of leader loss among seed sources, and have accepted the fact that corrective pruning will be necessary on practically all planted walnut trees to produce a straight bole, unless sufficient numbers of trainers or nurse trees are present. The interesting finding from this study is that there was considerable variation in growth of seedlings from seed collected from different stands (Table 1). There was a downward growth trend with increasing seed source elevation (Figure 1), but even at high elevations there were some stands which produced seed that grew well, and conversely, at low elevations there were some stands which produced seed that grew poorly.

Black walnut is famous for picking out small micro-site differences in what appear (to the eye) to be uniform sites. This often results in great variation in height growth even within small plots that appear uniform. Our blocks were 138.6 feet across slope by 99.0 feet up and down slope. Rows ran up and down slope. The blocks appeared to be fairly uniform (the best we could do). Height growth was extremely variable, and individual tree heights at age 9 ranged from .4 to 15.2 feet in block 1, 1.1 to 14.6 feet in block 2, and 2.0 to 26.5 feet in block 3. Because of this large amount of variation, the seemingly large differences in average heights among sources at age 9 (Table 1) were not significantly different in an analysis of variance (probability of a larger $F = .183$). The regression of average height at age 9 over seed source elevation (Figure 1) was statistically significant, however (probability of a larger $F = .018$).

Table 1. Average height at age 9 by tract, county, and elevation.

Tract	County	Elevation (feet)	Average Height at Age 9 (feet)
Arwine	Loudoun	1100	10.41
Whitney Stone	Albemarle	670	10.38
Grace Adams	Frederick	650	10.10
Harry Robinson	Madison	1500	10.03
R. L. Sanford	Orange	480	9.96
Douglas Dofflemeyer	Page	1700	9.84
P. R. Hostetter	Rockbridge	2400	9.74
Everett	Loudoun	580	9.73
Harris	Loudoun	700	9.19
Victor Weirs	Rappahannock	1440	9.09
Raymond Johnson	Rappahannock	1220	9.06
R. S. Graves	Madison	630	9.04
Virginia Game Commission	Madison	1420	8.98
W. J. Tyrell	Shenandoah	1200	8.75
T. B. Dilworth	Rockingham	1000	8.51
Gale Richmond	Augusta	1650	8.27
W. S. Royston	Warren	600	8.14
D. R. Vinning	Greene	2000	8.12
Taft Hughes Farm	Amherst	2065	8.03
Shannon Maloy	Highland	2000	7.27
Thomas on Snow Mountain	Greene	2400	6.88

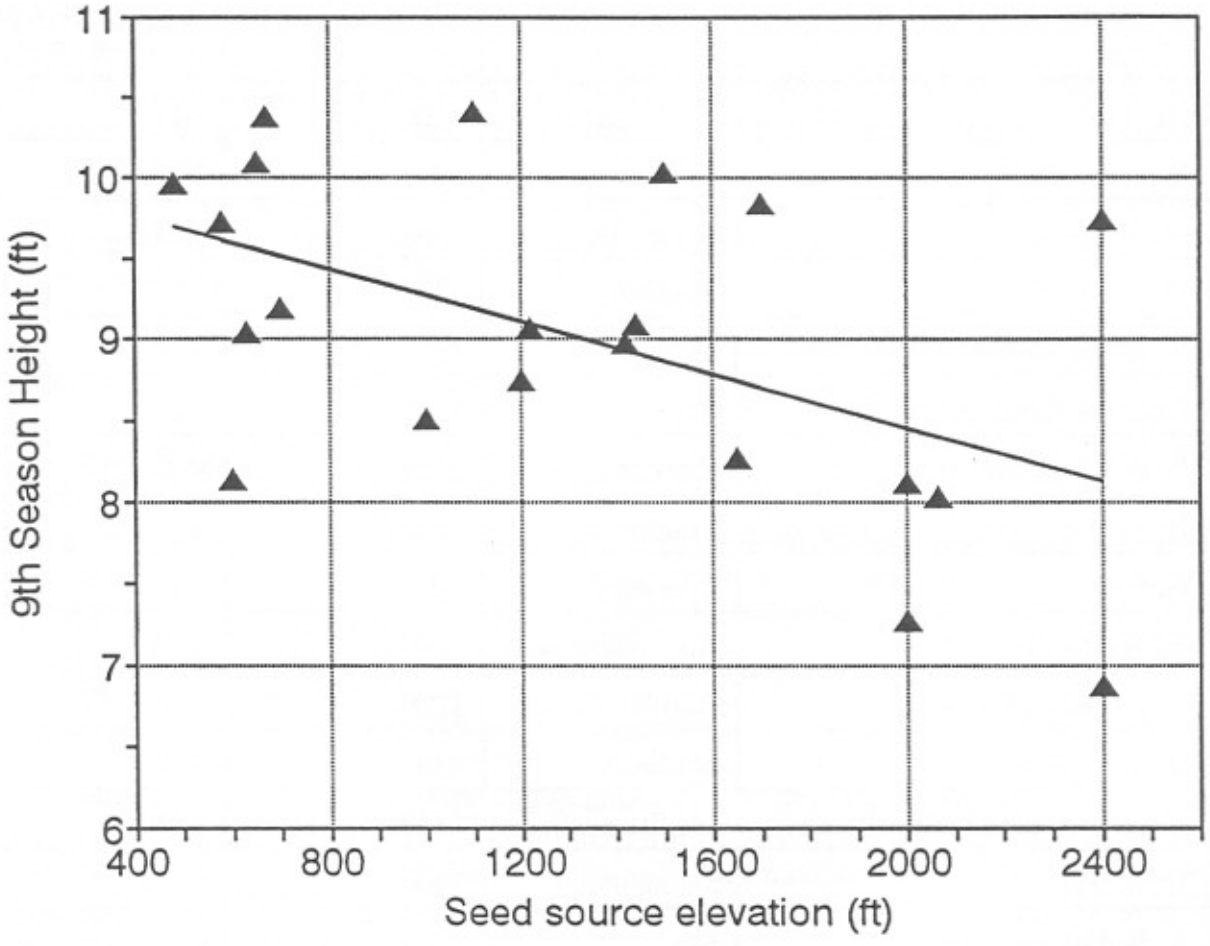

Figure 1. Average height of each source at age 9 over elevation of each source.

The larger seedlings were selected for planting when the seedlings were lifted, as already mentioned, and this may have biased results in favor of the sources that produced the most seedlings. Heights were measured immediately after planting, and average heights for the 21 sources ranged from 1.06 to 1.86 feet, and part of the variation in height after planting is related to the number of seedlings available in each source (Figure 2). At age 9, the tallest sources were not the ones which were tallest after planting (Figure 3), nor were they the sources that produced the most seedlings in the seedbed (Figure 4). This suggests that the effect of initial differences in seedling size had "washed out" by age 9, and little or no bias may have resulted from the way seedlings were selected for planting.

We should not be surprised at the variation among sources. Most black walnut stands are fairly small, and there is probably a considerable amount of genetic relatedness among trees in small, scattered stands. In many cases a stand will develop from seed from a single tree or just a few trees, and if these parent trees happen to be fast growers, their progeny will tend to be fast growers.

This study has implications for the landowner who is considering establishing a stand by direct seedling. He would be wise to collect nuts from many different stands and mix the seed thoroughly, so as to increase his chances of having fast growers scattered through his plantation. If he collects all of his seed from just one stand, or even worse, from just one tree, no matter how pretty it is, he runs a risk of obtaining relatively slow growing seedlings. The fact that a walnut tree, or a stand of trees, is of better-than-average quality does not mean that its growth rate has been better than average. For example, the seed collected from the Gale Richmond tract in Augusta County has not grown well, but we have a growth plot in this stand and the trees are of good quality. Also, in our many planting studies we notice that the fastest growers often tend to be "wild" and need the most corrective pruning. Therefore, if we are going to have to correctively prune anyway, we might as well spend our time correcting the fastest growing trees available.

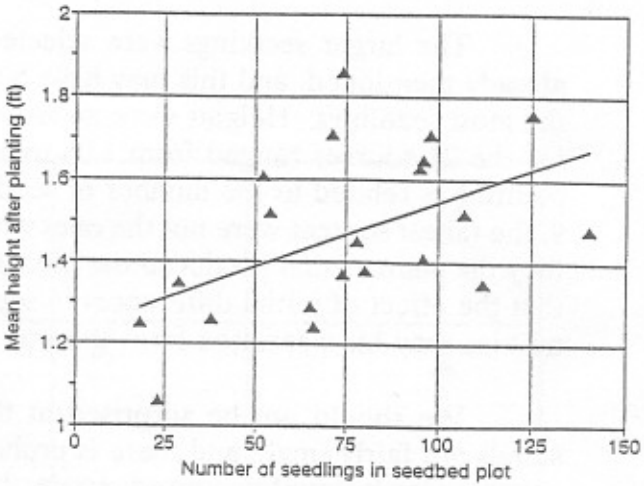

Figure 2. **Average height of each seed source after planting over number of seedlings available in seedbed.**

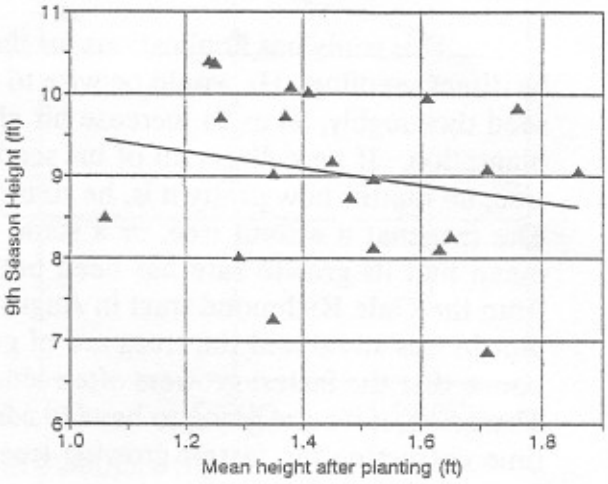

Figure 3. **Average height of each source at age 9 over average height after planting.**

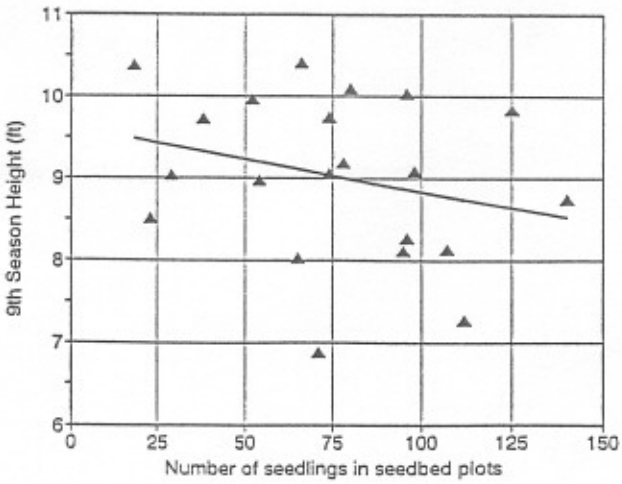

Figure 4. **Average height of each source at age 9 over number of seedlings available in seedbed plots.**