

How Acorn Size Influences Seedling Size and Possible Seed Management Choices

Robert P. Karrfalt

Robert P. Karrfalt is Director, National Tree Seed Laboratory, 195 Marsteller Street, West Lafayette, IN 47907-2003; telephone: 765.494.3607; e-mail: rkarrfalt@fs.fed.us

In: Riley, L. E.; Dumroese, R. K.; Landis, T. D., tech coords. National proceedings: Forest and Conservation Nursery Associations—2003; 2003 June 9–12; Coeur d'Alene, ID; and 2003 July 14–17; Springfield, IL. Proc. RMRS-P-33. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Keywords: seed vigor, seed sizing, *Quercus rubra*, *Quercus alba*

Introduction

Seed size has been found to influence seed vigor and seedling size in many plants. Some nurseries size acorns for the purpose of producing more uniform seedlings. No carefully constructed data set has been published that quantifies the advantages of this practice. Therefore, a study was set up to do this; initial results are presented in this paper.

Methods

Four state-owned nurseries were used as test sites: Vallonia State Nursery and Jasper-Pulaski State Nursery (IDNR) in Indiana, Wilson State Nursery (WDNR) in Wisconsin, and Penn Nursery (PDCNR) in Pennsylvania. Red oak (*Quercus rubra*) was planted at each of the 4 nurseries. White oak (*Q. alba*) was planted at Vallonia and Penn. Each nursery provided one of its own seed lots for each species planted. This gave a total of 4 red oak seed lots and 2 white oak seed lots. Prior to planting, the acorns were floated and sized with round-hole screens into as many sizes as were possible using the following screen sizes: 44, 46, 48, 50, 52, 54, 56, 58, 60. Acorns were planted by hand in 3-ft (1-m) long plots, with 24 acorns in each of 5 rows to obtain (assuming a survival factor of 0.80) a seedling density of 8 seedlings/ft² (86 seedlings/m²). A 1-ft (0.3-m) plot was marked in the center of the 3-ft plot with a small piece of flagging fastened to the ground by piercing it through the center with a 12d nail. This center 1 ft (0.3 m) was the measured plot; the outer 2 ft (0.6 m) served as borders from the adjoining plots. Plots were contiguous down the bed. The experimental design was a randomized complete block. Cultural conditions were the same as production stock, with the exception that there was no top clipping. At lifting, the seedlings were mechanically undercut and lifted by hand with each plot being placed into a separate bag. The following morphological measurements were made on every lifted seedling: stem diameter 25 mm (1 in) above the root collar to the nearest mm, total height in cm, fresh weight in grams, and root volume in cc. Root volume was determined using the water displacement method. A bucket of water was placed on a scale. The bucket contained a chamber held free from the sides and bottom of the bucket by a support rod held by a ring stand. The reaction force to the buoyant force generated by submerging the seedlings roots was measured on the scale and used as the root volume. Plot means were analyzed by simple linear regression.

Results

There were 10 sizes of red oak at the Jasper-Pulaski Nursery and 8 sizes at the Wilson Nursery. Seedlings were not available from the Penn Nursery due to its short growing season; however, the seedlings grew well and will be examined fall 2003. The first summer at Vallonia was very hot and dry, rendering the experiment there unusable.

Regressions of the plot means were significant for all measured variables when regressed against acorn diameter (Figures 1 through 4). As acorn size increased, the average size of the seedling increased for all 4 morphological traits measured. Wilson Nursery provided the one exception in that the largest size acorns produced small seedlings. This has no apparent explanation. The data was very similar at both nurseries, so only the graphs from Jasper-Pulaski are shown here.

Discussion and Conclusions

This study demonstrated very clearly that the larger the acorn, the larger the average seedling would be in diameter, height, fresh weight, and root volume. Acorn sizing appears to be one tool the nursery manager can use to produce larger seedlings.

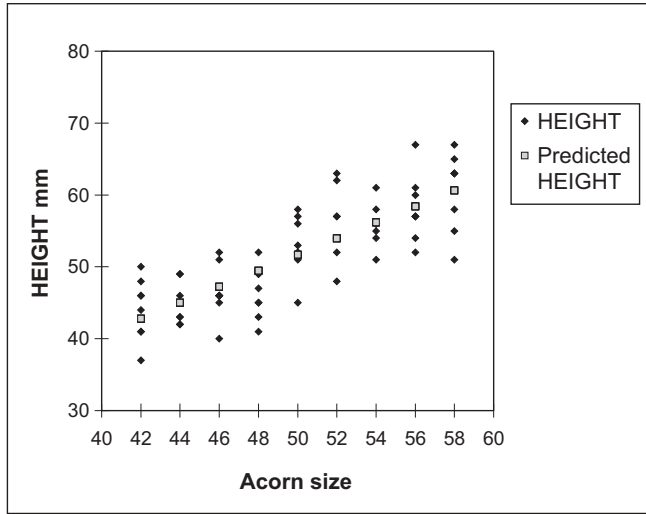


Figure 1—Seedling height versus acorn size at Jasper-Pulaski Nursery.

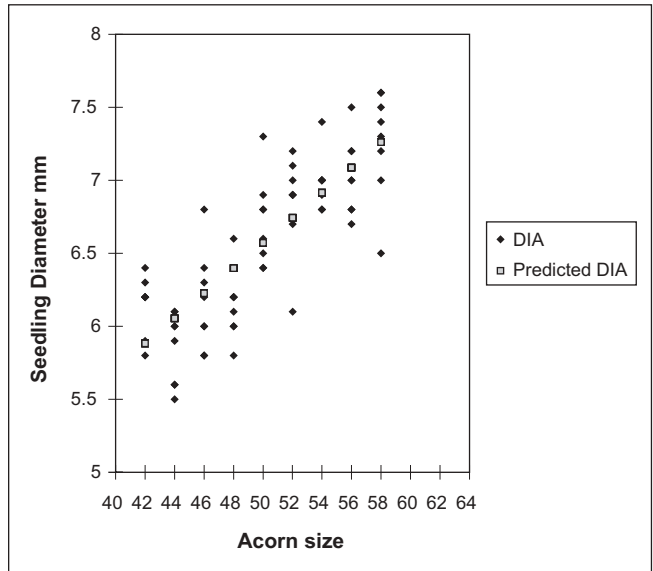


Figure 2—Seedling diameter versus acorn size at Jasper-Pulaski Nursery.

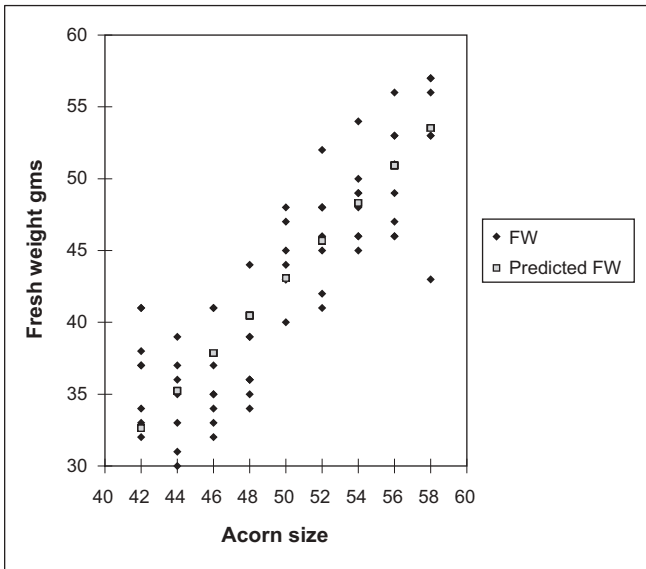


Figure 3—Seedling fresh weight versus acorn size at Jasper-Pulaski Nursery.

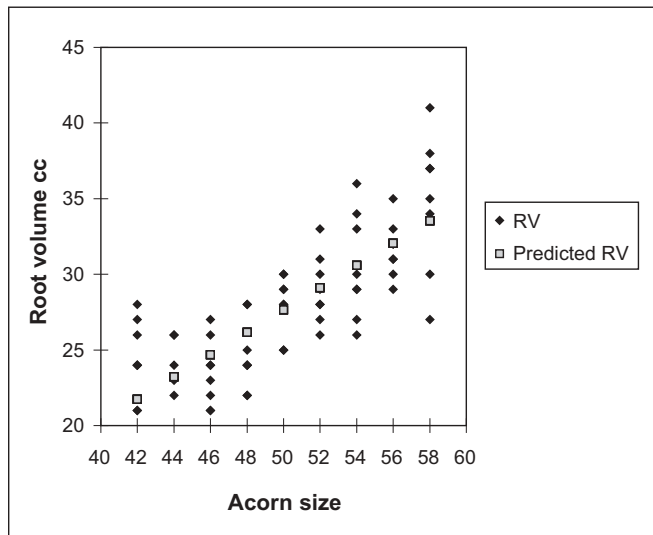


Figure 4—Seedling root volume versus acorn size at Jasper-Pulaski Nursery.

However, discarding small acorns should not be practiced unless there is good genetic evidence to demonstrate the practice is not discarding whole families with possible good growth potential. Even the small acorns produced seedlings of acceptable size, although cull rates appeared to be higher in the small acorn classes. Cull rates have not yet been calculated from the data.

Acorn sowing density possibly needs to be matched to acorn size to optimize growth rate. It might be that small acorns produce fewer seedlings with the potential to make grade. If the better growers in the small acorn size can outgrow the poor growers sufficiently well, then a higher

sowing density might give more plantable seedlings per square unit of bed. In the other direction, a lower sowing density for large acorns could produce even a larger seedling in 1 season.

An additional strategy may well be to grow the small acorns as 2+0 seedlings while the larger acorns could go for 1+0 seedlings. Such a strategy would allow for extending seed supplies over several crops of seedlings. This would essentially be storing acorns “on the stump.” It would be necessary to determine if the smaller seedlings would eventually catch up in growth potential to the large seedlings before this strategy is adopted.