HORTSCIENCE 37(1):206–207. 2002.

Cercis canadensis L. Seed Size Influences Germination Rate, Seedling Dry Matter, and Seedling Leaf Area

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Additional index words. seed vigor, Eastern redbud, seed quality

***Abstract.* Several studies with annual crops have shown that large seeds improve percent germination, seedling growth, and uniformity, yield, seedling vigor, and stress tolerance. Little information is available on the influence of seed size on the resulting seedlings of woody plant species. *Cercis canadensis* L. seeds were divided into large and small seed size fractions and the seeds scarified, stratified, and planted. A larger percentage of large seeds germinated than did small seeds. Seedlings from large seeds had a greater peak and germination value than small seeds, indicating greater vigor and a more rapid germination rate thus more uniform seedlings. Seedlings from large seeds, as indicated by fresh and dry weights, were larger and contained a greater leaf area than those produced by small seed.**

Eastern redbud, a small- to medium-size tree native to both the southern and northern areas of the eastern United States, is an important landscape plant. Stem or root cuttings are difficult to root or root in an erratic manner (Dirr and Heuser, 1987). Because of the difficulty encountered in rooting the species, redbud trees are propagated from seed and once the seedlings reach sufficient size, they are grafted or budded with scions/buds from preferred cultivars (Geneve, 1991), or grown and sold as seedlings. As a consequence, it is important to begin with high-quality seed that will produce a uniform stand of vigorous seedlings. Seedling uniformity is critical since variation in vigor results in shading of the smaller plants and slower plant growth (Webster, 1964). Good germination is also important due to rising production and labor costs. The first step in obtaining vigorous and uniform seedlings is to begin with seed of good viability and vigor. Seedling vigor has been studied in many annual vegetable crops (Smith et al., 1973a, 1973b; Smittle et al., 1976; Stoffer and Smith, 1974; Webster, 1964) and is correlated with uniform seedling growth, uniform crop maturity, yield, disease resistance, and stress tolerance.

Webster (1964) reported that lettuce seed weight was an important parameter for predicting seedling vigor. Kiesselbach (1924) summarized over 10 years of work on wheat and oats that showed that small seed produced nonuniform seedlings of low vigor that yielded less than plants from larger seed. Although there is considerable information on the effect of seed size on various germination, seedling, and yield parameters of annual horticultural and agronomic crops, little information is available on the relationship between seed size and seedling vigor, uniformity, and growth in woody plant species. Any factor/practice that results in higher vigor and more uniform seedlings for rootstocks or ornamental plantings is of interest to plant propagators. This study was initiated to ascertain the impact of Eastern redbud seed size on the germination quality attributes of resulting seedlings.

Received for publication 12 Feb. 2001. Accepted for publication 18 June, 2001. Mention of brand names is for information only and does not constitute an endorsement to the exclusion of other products that might also be suitable.

Materials and Methods

Eastern redbud seeds were collected on 17 Feb. 2000 from seedling trees growing in Athens, Ga. Individual seeds were weighed and divided into two fractions according to seed weight. One fraction (low seed weight) contained seeds that weighed from 19.7 to 28.5 mg, while a second fraction (high seed weight) contained seeds that weighed from 29.7 to 32.9 mg. A total of 200 seeds per size fraction were used. All seeds received a 30-min acid scarification treatment with concentrated sulfuric acid. Following scarification, the seeds were rinsed three times in distilled water and then placed in cold-moist stratification at 8 °C for 90 d (Geneve, 1991). The stratified seeds were removed from moist-cold storage on 30 May 2000 and each size fraction was divided into four replications of 50 seeds per replication and planted in flats filled with a standard germinating mix composed of peat, perlite, and pine bark. The statistical design was a randomized block. The seed-filled flats were placed in a growth chamber at 24 °C day/night (±2 °C) temperature regime and a 12-h photoperiod. Germination data were recorded daily. On day 16 following planting, 15 seedlings per replication were harvested by washing the germinating mixture from the seedlings, blotting the seedlings dry and then weighing each seedling to obtain the fresh weight. The seedlings were then dried at 71 °C for 5 d and the dry weights determined. On day 44 following planting, the remaining seedlings were harvested similarly and the fresh weights recorded. The leaves were then removed and the leaf area was determined for each replication using a LI-COR model LI-3000 portable area meter (LI-COR, Lincoln, Neb.). The leaves, roots, and stems of each replication were then combined, dried as previously described, and the dry weights recorded. All data were analyzed by analysis of variance and the means separated by Duncan's multiple range test. Germination percentages calculated were arcsin transformed before statistical analysis. The peak value (ratio of cumulative germination percentage and number of days from the beginning of the germination test), germination value (the product of the peak value and the mean daily germination percentage), and mean daily germination percentage (the ratio of the final germination percentage and the number of days required for the completion of germination) were determined according to the method of Czabator (1962).

Results and Discussion

A significantly higher percentage of large seed germinated than small seed (Table 1). These data are similar to those reported for lettuce (Smith et al., 1973a, 1973b; Soffer and Smith, 1974), 'Fordhook' lima bean (Webster and Jorgensen, 1956), sweet corn (Cameron et al., 1962), and lima beans (Webster, 1964), where large seed displayed a higher percent germination than small seed. Large redbud seed produced seedlings with a greater peak value, indicating a higher level of vigor than small seed (Table 1). The germination value, which combines rate and percent germination into a single index, was greater for large seed than small (Table 1), indicating that large seed germinated at a faster rate, which contributed to seedling uniformity. On both harvest dates, 16 and 44 d following planting, seedlings from the large seed fraction, as indicated by fresh and dry weights, were larger than seedlings from smaller seed (Table 1). As would be expected, seedlings from large seed produced a greater leaf area per seedling than seedlings from small seed (Table 1). These data show that Eastern redbud seedlings derived from large seed are of greater vigor, have a higher percent germination, and are more uniform than seedlings from smaller seed. This has been reported for several annual crop plants. Separating redbud seed into seed weight fractions of various sizes and planting each seed size separately would provide growers with more uniform seedlings of various vigor levels and germination rates. The larger seed would be the more desirable because they would produce larger plants with the greater vigor. Although seedlings from smaller seed would be smaller and less vigorous, when planted separately from larger seed they would produce more uniform seedlings, an advantage that would maximize seedling growth in the seed bed due to a minimization of mutual shading. Since there are many inexpensive mechanical methods by which seed can be separated into different sizes (Smittle et al., 1976), seed separation by weight can be accomplished economically. These data point out the need for additional research on seed size effects with other woody perennials.

Table 1. Percent germination, mean daily germination percentage, peak value, germination value, seedling growth, and leaf area of *Cercis canadensis* as influenced by seed size.

Treatment[z]	Percent germination	Mean daily germination Percent[y]	Peak value[x]	Germination value[w]	Dry wt (mg/seedling) 16 d after planting	Fresh wt (mg/seedling) 16 d after planting	Dry wt (mg/seedling) 44 d after planting	Fresh wt (mg/seedling) 44 d after planting	Leaf area (sq cm/plant) 44 d after planting
Small seed (19.7–29.5 mg/seed)	63 a	8.5 a	7.1 a	60 a	13.8 a	133 a	135 a	586 a	39.3 a
Large seed (30–32.6 mg/seed)	91 b	11.7 b	11.8 b	138 b	17.3 b	170 b	206 b	700 b	58.9 b

[z]Means, in columns, followed by the same letter are not statistically different at the 5% level according to Duncan's multiple range test.
[y]Mean daily germination percent = the ratio of the final germination percent and the number of days required for the completion of germination.
[x]Peak value = the ratio of cumulative germination percentage and the number of days from the beginning of the germination test.
[w]Germination value = the product of the peak value and the mean daily germination percentage.

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