LIFTING DATE AND STORAGE AFFECT ROOT REGENERATION POTENTIAL OF BLACK WALNUT SEEDLINGS

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Abstract.--Seedlings lifted too early in the fall and stored over winter showed low vigor in root regeneration potential (RRP) tests in the spring. Seedlings lifted when dormant stored well and had acceptable RRP, if chilled completely. Highest RRP occurred in seedlings lifted just before bud swell in early spring. Seedlings should be lifted and stored about 1 month after leaf fall for early-spring planting and just before bud swell for late-spring planting.

Additional keywords: Physiological quality, chilling, Juglans nigra.

Lifting hardwood nursery stock in the fall rather than in spring has become more common because of such seasonal advantages as: better soil conditions, lighter workloads, more available labor, earlier confirmation of stock availability, and prompter delivery of stock to planting sites in the spring.

Black walnut (Juglans nigra L.) is one of the first species to be lifted in the fall, because leaf fall occurs early and seedlings seem to be dormant. However, leaf fall only indicates that dormancy has begun; it does not indicate when seedlings should be lifted. Lifting and storing guidelines for black walnut need to be developed based on convenient criteria for identifying seedling readiness.

To learn more about the effects of lifting date and storage, we conducted root regeneration potential (RRP) tests on black walnut seedlings. RRP, a measure of the seedling's capacity to promptly initiate and elongate new roots when planted in a favorable environment, is correlated with field survival (Stone and Schubert 1959, Stone and Jenkinson 1971). Effective physiological preconditioning of planting stock depends on lifting at the proper time, storing under appropriate conditions, and planting when RRP is highest. This paper reports the results of our study and discusses the feasibility of using RRP tests to evaluate nursery stock and its suitability for outplanting.

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METHODS

Eleven bi-weekly liftings of 1-0 black walnut seedlings were made between October 6, 1976 and April 25, 1977, from the Vallonia Forest Nursery, near Brownstown, Indiana. The October 6 lifting was about 7 days before leaf fall and the April 25 lifting was about 10 days after flushing. Each lot of seedlings was graded to minimum stem caliper of 0.7 cm and root pruned to 22 cm. Twelve seedlings from each lot were potted at each of the following times: immediately, 4, 8, and 12 weeks after lifting, and on December 8, March 8, and May 12. Seedlings were stored at 3 °C until potted.

Root regeneration potential of these potted seedlings was determined by a method similar to that of Stone and Schubert (1959). The seedlings were placed in a greenhouse where a 16-hour photoperiod and a 24 °C-soil temperature were maintained. Air temperature in the greenhouse varied seasonally (minimum 16 °C). At the end of 4 weeks, the seedlings were unpotted. Total shoot elongation, stem caliper 2.5 cm above root collar, ovendry weight of all new roots, and ovendry weight of the total root system were measured for each seedling. Lifting date and storage treatments were compared for significant differences by analysis of covariance--total root dry weight was the covariable for root growth response and stem caliper was the covariable for shoot growth response.

RESULTS

Our study showed that date of lifting seriously affected the physiological quality of black walnut planting stock. Seedlings lifted from late fall (about 1 month after leaf fall) to the time of bud swell in spring maintained acceptable RRP in storage (fig. 1). Growth response was divided into two significantly (P 0.05) distinct groups: (1) seedlings lifted on October 6 and 18 had low root and shoot growth, and (2) seedlings lifted between November 1 and April 25 had moderate root growth (differences among these nine lifting dates were nonsignificant) with moderate shoot growth in fall and significantly higher shoot growth in spring.

The best spring-lifting date for immediate planting or extended storage was just before bud swell. Seedlings lifted and stored then, on April 11, maintained the highest physiological quality in extended storage. RRP for these seedlings increased during storage (177 mg at lifting, 197 mg on May 12, 311 mg on June 6). In contrast, the seedlings lifted after flushing on April 25 declined with longer storage (249 mg at lifting, 231 mg on May 12, and 118 mg on June 20). The lowest RRP value would be considered unacceptable when compared to an average RRP of 182 mg for seedlings lifted between November 1 and April 25 (fig. 1).

All seedlings required exposure to cold temperatures for a definite amount of time before showing any growth in RRP tests. Seedlings stored to December 8 had no RRP because of inadequate chilling. In those stored to March 8, the chilling was minimally complete and RRP was uniformly low. In contrast, seedlings stored to May 12 (fig. 1) had vigorous root regeneration and shoot growth that differed significantly among lifting dates.

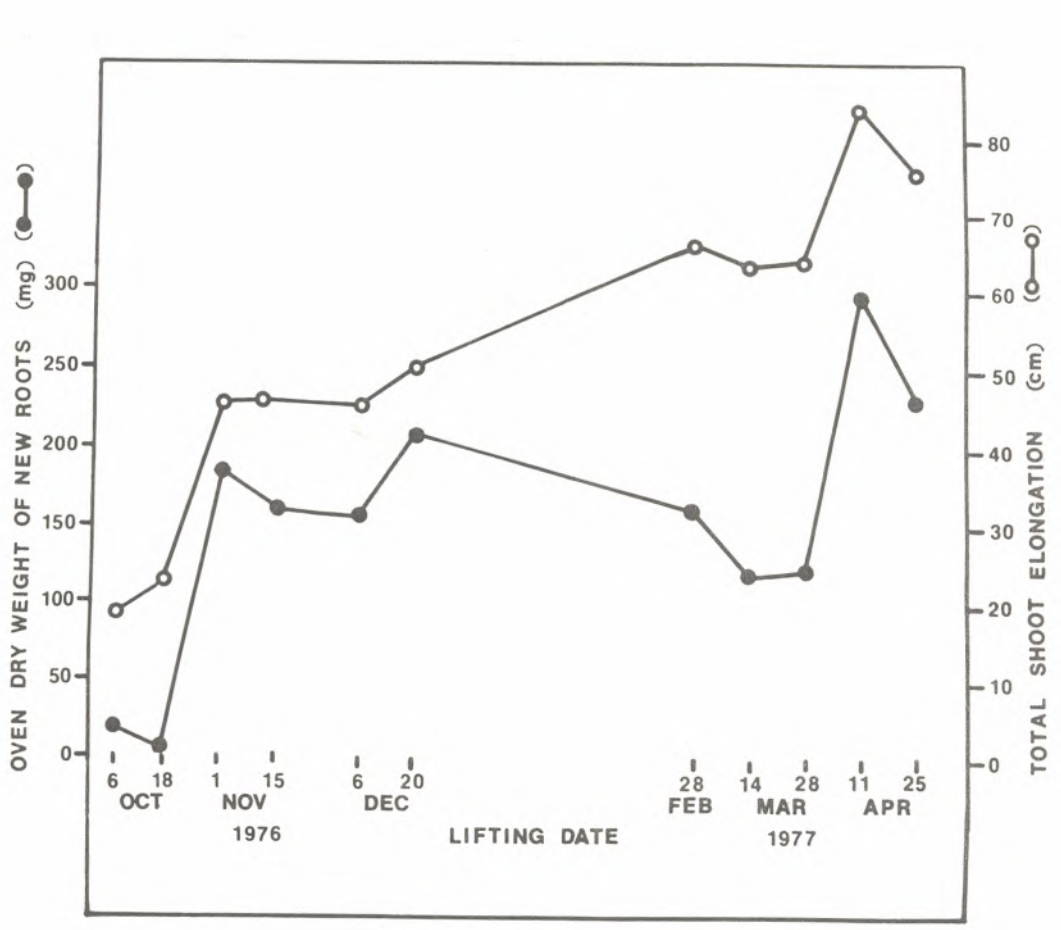

Figure 1.--Root regeneration and shoot growth potential of black walnut seedlings lifted on different dates and stored to May 12. Twelve seedlings representing each lifting date were potted and grown in a greenhouse for 4 weeks.

DISCUSSION

Seedlings lifted before November 1 had reduced vigor after overwinter storage. Although these seedlings received more chilling than seedlings lifted later, their RRP on May 12 was much lower. The seedlings lacked vigor because they were lifted too early and were not sufficiently cold-hardened to withstand lifting and cold storage. These results show that lifting date is an important factor affecting the quality of black walnut planting stock. Because the time when seedlings are ready for lifting varies from year to year and nursery to nursery, independent criteria are needed to determine lifting dates; research is underway to develop these guidelines. A rough criterion would be to wait 1 month after leaf fall before lifting black walnut seedlings.

Chilling is extremely important in determining the rapidity and total amount of root and shoot growth. When inadequately chilled seedlings are planted in a favorable environment, they resume growth slowly and then grow sluggishly. Stored black walnut seedlings need a minimum of 3,100 hours of chilling at 3 °C (Rietveld and Williams 1978); they need about 3,500 hours for vigorous growth. Generally the more chilling the seedlings receive, the more rapidly they resume growth and the greater is their growth response during the 4-week test period.

Root regeneration potential seems to be a good way to evaluate the effects of lifting and storage on black walnut planting stock that has been adequately chilled. A method of evaluating the physiological quality of hardwood planting stock before planting time would be highly useful in culling low vigor stock. Such a method has been proposed for coniferous planting stock by Hermann and Lavender (1979). Based on an RRP-type test where seedlings are potted, this method relates planting stock quality to days to bud burst and survival after a specified period of time. A similar method could be devised for black walnut and other hardwoods, if the extremely long chilling process in hardwoods could be accelerated. Although most northern and western conifers require only 1,000-2,000 hours of chilling, most eastern hardwood species require 2,500-3,500 hours before vigorous growth will occur. Hardwood planting stock cannot be completely chilled, and RRP tests run and grading completed in time for early spring planting. Unless RRP tests can be completed in late winter before the spring planting season, their usefulness for other than research purposes is questionable.

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