

Adaptability of Black Walnut, Black Cherry, and Northern Red Oak to Northern California

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*When planted in sheltered sites in northern California, only 49% of black walnut (*Juglans nigra* L.) and 58% of black cherry (*Prunus serotina* Ehrh.) survived for 15 years, and 20% of northern red oak (*Quercus rubra* L.) survived for 10 years. The black walnut trees averaged 0.6 inches diameter at breast height (dbh) and 5.4 feet in height when measured at 15 years; the black cherry trees averaged 2.1 inches dbh and 20.3 feet in height. The northern red oak seedlings taller than breast height averaged 1.0 inch dbh and 3.8 feet in height. In northern California, only the black cherry shows any promise as an economically valuable species for sheltered sites. Tree Planters' Notes 38(4):31-36; 1987.*

This study was based on the premise that owners of small tracts of forest land—that is, nonindustrial forest landowners need to realize a relatively high rate of return at harvest. And what higher rate than from valuable eastern hardwoods? But how would such species as walnut, cherry, and oak survive and grow in northern California? A comparison of environments indicated at least some similarity in site characteristics, high and low temperatures, length of growing season, and lack of serious pests. The chief difference was insufficient summer rainfall in northern

California. However, careful selection of planning sites could at least partially overcome this drawback.

This paper describes the survival and growth of black walnut, black cherry, and northern red oak in northern California and gives insight to the adaptability of these species.

Methods

The study site was located on the Challenge Experimental Forest in northern California. This experimental forest is characterized by deep soil, plentiful winter rainfall, dry summers, and warm temperatures. The soils are deep, moderately well drained, quite fertile, reddish in color, and range in texture from clay-loam to clay. The principal soil series—Sites, Aiken, Josephine, and Tish Tang—are found extensively at low to middle elevations throughout the Sierra Nevada, Cascade, and Coast ranges.

Annual precipitation, based on a 43-year record, averages 68 inches, with 4 inches falling from May through September. The average midsummer maximum temperature, also based on a 43-year record, is 90 °F and the midwinter minimum is 30 °F. The growing season is about 200 days.

To lessen the harshness of the long, rainless California summer, and to best approximate the candidate species' native environ-

ment, the study area was located in a small valley on gently sloping land bisected by two ephemeral streams. The valley was bordered by tall native conifers and hardwoods. This sheltered cove site probably had more available water, at least during spring, and received less direct sunlight than most areas on the forest. The elevation was about 2,700 feet.

In preparation for planting, all conifers and hardwoods in the natural forest were bulldozed into windrows near the edge of the study area in December 1966 and eventually burned. This form of site preparation left the soil loose and friable and the planting site weed-free.

This study was considered introductory, as a first look at the performance of the three species in an untested environment. Hence, it was without replication.

Black walnuts (*Juglans nigra* L.) from Tennessee, Kentucky, Iowa, and Illinois were seeded directly into prepared spots in the study area in May 1967. Seed spots were spaced 8 by 8 feet. Walnuts were placed 2 inches deep, 2 or 3 nuts per spot, and protected from animals by a partially buried cone-shaped screen.

After germination, 355 seedlings were available for study. Where more than one seedling per spot was present, the weaker seedling was either removed or marked with a colored pin. Only

the most vigorous seedling in each spot was counted for survival and measured for growth. A handful (about a quarter pound) of 16-20-0 (N-P-K) fertilizer was applied to the soil surface uphill from each spot in the spring of 1968.

Although the area was kept free of competing shrubs and hardwood trees, it was impossible to keep out all vegetation. Various grasses, forbs, and ferns soon became abundant. This vegetation was periodically hand grubbed from around the walnut seedlings and never allowed to overtop them. Because the area was close to running water, herbicides were not applied.

Black cherry (*Prunus serotina* Ehrh.) seed was received from Pennsylvania in 1967. The seed trees were designated as "plus tree candidates" and were described as tall, with narrow crowns and rapid height growth. The seeds were germinated in a greenhouse and individually placed in quart-sized milk cartons. The seedlings grew for 1 year, were hardened off during winter in a lathhouse, and then were transferred to the experimental forest. Planting area, site preparation, and spacing were like those for walnuts. The milk cartons were removed and each black cherry seedling was outplanted as a plug. A handful of 16-20-0 (N-P-K) fertilizer was placed uphill from each seedling

when planted. One hundred seedlings were included in the black cherry trial. To prevent deer browsing, each seedling was protected with a circular wire screen 4 feet tall.

Northern red oak (*Quercus rubra* L.) acorns were obtained from North Carolina in fall 1970. After stratification, the acorns were germinated in the laboratory and placed in tarpaper pots, 2 inches square by 6 inches deep. Seedlings were grown for one season in a greenhouse, hardened-off in a lathhouse, and then transferred to the experimental forest in March 1972. Each was planted as a plug in a prepared spot.

Spacing and fertilization were like those for walnut and cherry.

The introductory trial for this species differed from the trials of the other species in that two areas were planted. One area, planted with 137 seedlings, developed a ground cover of primarily bracken fern (*Pteridium aquilinum* [L.] Kuhn var. *pubescens* Underw.). The other area, planted with 239 seedlings, developed a cover of blue wild rye (*Elymus glaucus* Buckl.).

Because of the dry spring, each seedling was irrigated with about a half gallon of water every 2 weeks from early June through mid-September 1972. The water was placed inside a small earthen berm surrounding each seedling. This was the only year that seedlings received supplemental water.

Table 1—Survival and growth of northern red oak after 10 years and black walnut and black cherry after 15 years on the Challenge Experimental Forest in northern California.

	Northern red oak (site 2)	Black walnut	Black cherry
Percent survival	20	49	58
Diameter at breast height (in)			
N	15	100	58
Mean	1.0	0.6	2.1
SD	1.5	0.4	0.7
Range	0.1–5.0	0.1–3.1	0.7–3.8
Height (ft)			
N	47	175	58
Mean	3.9	5.4	20.3
SD	3.8	3.4	5.1
Range	0.4–24.3	0.4–22.3	9.2–29.9

N = number of samples, SD = standard deviation.

Results and Discussion

Black walnut. Late spring frosts were particularly severe in 1970 and 1971, killing new leaves and shoots and occasionally entire plants. The years 1976 and 1977 were droughty, 1977 particularly so. Eighty walnut seedlings, or nearly 23% of the total, died during this period. After 15 growing seasons, the number of living black walnut plants decreased to 175, for a survival rate of 49% (table 1).

The effect of competing vegetation was obvious: where vegetation was dense, walnut seedlings died or were weak; where vegetation was sparse, walnut seedlings survived and grew well. Dieback was severe. Some walnut seedlings died back to groundline and resprouted, often every second or third year. However, they rarely recovered, and most eventually died. The major cause of mortality was probably inadequate soil moisture resulting from lack of summer rain and competition from forbs and grasses.

Of the surviving 175 seedlings, only 100 reached breast height; average dbh of black walnut seedlings after 15 years was 0.6 inches, with a range of 0.1 to 3.1 inches (table 1). Average height of all walnut seedlings was 5.4 feet, with a range of 0.4 to 22.3 feet. The shorter seedlings died back and resprouted several times, each time becoming less



Figure 1—Form of 6-year-old black walnut seedlings on the Challenge Experimental Forest, California.

vigorous. Surviving seedlings tended to be of poor form (fig. 1). Forking was common and development of at least one large branch on each seedling was commonplace. In addition, groundline sprouting sometimes resulted in two, occasionally three, stems, which often leaned or were j-shaped.

Black cherry. The abundance of grasses and forbs in the study area was a major cause of cherry seedling mortality. Pocket gophers (*Thomomys* spp.) also contributed to the mortality. An unidentified species of sawfly killed some lateral branches and a few terminal shoots of the seedlings when they were 6 and 7

years old. Neither late spring frosts nor the drought of 1976-7 were a threat to black cherry. From 1975 through 1978, for example, only seven seedlings died.

Some branch tips and some branches in the upper crown of a few trees did die during these drought years, however. A few seedlings were damaged by deer reaching over the screens and devouring tender tops. Had the screens not been installed, deer damage probably would have been more severe.

Survival of black cherry seedlings was 58% after 15 years. Average dbh was 2.1 inches, with a range of 0.7 to 3.8 inches (table 1). Every surviving seedling was at least breast high. Average height was 20.3 feet, with a range of 9.2 to 29.9 feet (fig. 2). Trees tended to have tall straight boles and narrow crowns. Forking of the main bole and development of large branches were rare. Three trees bore fruit when 7 years old and 12 to 15 feet tall. After 15 years, 10 trees were bearing fruit.

The first northern red oak plantation, with blue wild rye as the dominant ground cover, was destroyed by pocket gophers after two growing seasons. Of the 137 initial plants, only 2 remained. Although some seedlings probably perished from grass-induced moisture stress, most died after pocket gophers consumed their



Figure 2—Height measurement of a typical 15-year-old black cherry on the Challenge Experimental Forest, California.

roots. Apparently, the grass attracted the gophers and led to loss of the plantation.

In the second northern red oak plantation, 102 seedlings (43%) died by the end of the second

growing season. The ferns became large and abundant, and the oak seedlings died from lack of soil moisture. After 10 years, only 20% remained (fig. 3). In April 1972, warm temperatures



Figure 3—An unusually large 6-year-old northern red oak on the Challenge Experimental Forest, California. Note the scattered, smaller oaks nearby.

were followed by a hard freeze, and terminal buds on almost all plants were killed. In most instances, a new shoot developed from a lower bud or a bud at groundline. Deer browsed about half of the seedlings in the first growing season but only an occasional seedling thereafter. Perhaps the fertilizer applied in the nursery had dissipated after the

first growing season and the seedlings were no longer as preferable.

Average dbh of northern red oak seedlings after 10 growing seasons was 1.0 inch, with a range of 0.1 to 5.0 inches (table 1). However, only 15 of the surviving 58 seedlings were at or taller than breast height. Average height was 3.9 feet with a range of 0.4 to 24.3 feet. As with black walnut and black cherry, a few oak seedlings found favorable microsites and were quite tall by the end of the study.

Conclusions

In this study, the walnut, cherry, and oak seedlings were given as many growth-enhancing treatments as practical: location on a sheltered site, creation of an initially weed-free area, initial fertilization, early irrigation (red oak), protection from animals (walnut and cherry), and continuous removal of woody plants. Therefore, we can consider this study indicative: if a species did not survive and grow well here, it probably will not perform well elsewhere in the forest zone.

Survival, growth, form, and overall vigor of black walnut and northern red oak were unsatisfactory after 15 and 10 years, respectively. Unless herbaceous weed control, protection from animals, and irrigation are provided, the likelihood of their becoming an economical re-

source in northern California's timber zone is low.

For black cherry after 15 years, overall vigor was good, growth was acceptable, and form was excellent. In its native habitat on the Allegheny Plateau of northern Pennsylvania, 15-year-old black cherry in clearcuttings would be 20 to 25 feet tall and 2 to 4 inches dbh (7), corresponding to a site index of 60 to 70 (2). In Pennsylvania, black cherry develops best under cool moist conditions where soil moisture usually is plentiful during much of the growing season.

The fact that the black cherry grew at least reasonably well in the summer-dry climate of California suggests that the species is quite adaptable. To date, the relatively high level of moisture stress that probably occurs each summer has had no lasting ill effects, other than to cause some branch death and dieback in the upper crown. Whether this dieback will worsen and affect future tree growth is unknown.

Moving a species far from its native range usually is risky. Extremes of climate and outbreaks of insects and disease often cause failure. Such adverse circumstances notwithstanding, black cherry shows promise as a valuable hardwood in northern California. This species was virtually unaffected by early spring frosts, two successive years of drought, and attack by at least one species of insect. For these

reasons and because of acceptable growth, further trails (particularly with weed control) should be considered.

References

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2. Auchmoody, L.R.; Rexrode, C.O. Black cherry site index curves for the Allegheny Plateau. Res. Pap. NE-549. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1985. 5 p.