Acorn Sowing Date Affects Field Performance of Blue and Valley Oaks

Douglas D. McCreary

Natural resources specialist, Department of Forestry and Resource Management, University of California-Berkeley, Browns Valley, CA

Acorns of blue oak (Quercus douglasii Hook. & Arn.) and valley oak (Q. lobata Nee) were sown at monthly intervals from November until March. The earlier acorns were sown, the earlier seedlings emerged. First-year and second-year height growth and survival were also related to sowing date with the smallest growth and lowest survival for seedlings from the latest sowing. These results suggest that late acorn sowing reduces the chances for successful field establishment. Tree Planters' Notes 41(2): 6 -9 ; 1990.

During the last several decades there has been increasing concern about the management of native hardwoods in California, especially oaks. Part of the concern has resulted from recent reports that several species, including blue oak (*Quercus douglasii* Hook. & Arn.) and valley oak (*Quercus lobata* Nee), are not regenerating well in portions of their ranges (2, 5). In addition to regeneration problems, the total acreage of these species has been depleted in recent years because of residential and commercial development, agricultural conversions, and firewood harvesting (1).

To address these concerns about poor natural regeneration and develop techniques for successfully artificially regenerating these species, a number of studies have recently been initiated (3). The following study was designed to develop information on optimal sowing dates for directly seeding acorns.

Methods

In late October 1987, 200 acorns were collected from individual blue and valley oak trees. Acorns with holes, cracks, or spots were discarded. Those remaining were divided into 5 groups of 30 and placed in a refrigerator (2 to 4 °C) in 1.75-mil-thick zipper-lock plastic bags, as recommended by Rink and Williams (6). From early November to March, one group of 30 from each species was sown every month in a plot at the University of California's Sierra Foothill Range Field Station, 20 miles northeast of Marysville.

The acorn planting area consisted of 30 rows, each containing 10 planting spots. The rows were 3 m long and .38 m apart. On each sowing date, acorns from each species were sown in three randomly selected rows. Acorns were planted with a hand trowel, on their sides, 1 to 2-cm deep.

On the first three sowing dates, soil moisture was near field capacity. For the final two dates, however, the soil was crusty and dry. To minimize the effect of initial soil moisture on germination, each acorn sown in February and March was irrigated with 180 ml water. No additional water was provided. The plot was kept free of weeds by spraying glyphosate in early February, and hand weeding thereafter.

Beginning in February, the plot was evaluated periodically to determine the date of shoot emergence for each acorn. An acorn was counted as emerged when the shoot was visible at the soil surface. Assessments were made twice a week through April, and once a week in May and June.

At the end of both the first and second growing seasons, year-end seedling height and survival were recorded. In spring 1989, each seedling was also evaluated twice a week for bud burst (leaves emerging through the bud scales). All of these variables were averaged for each row and statistically tested according to the analysis of variance and least significant difference (LSD) tests. For calculating row averages of height growth, emergence and bud burst, dead or absent seedlings were treated as missing values so that survival differences did not influence the data. Differences reported as significant were at the $P < 0.05$ level.

Results

Seedling emergence was closely related to sowing date. Acorns that were sown earliest were the first to send up shoots (figs. 1 and 2). Subsequent sowings came up progressively later. The blue oaks began to emerge in mid-February, and the first valley oaks appeared 2 weeks later. There were significant differences in average emergence date between sowing dates and species.

There were also significant differences in first-year and second-year height growth among both sowing dates and species. Since there were no interactions, these values were averaged over species (table 1) and sowing dates (table 2). For both years, the least growth occurred in seedlings sown last, and the most in seedlings sown first.

Valley oaks grew almost twice as much as blue oaks during the first growing season. Although the valley oaks continued to grow significantly taller the second season, the magnitude of this difference was less than the first year. For blue oaks, average height growth the second year was approximately the same as it was the first year. For valley oaks, it was only about half.

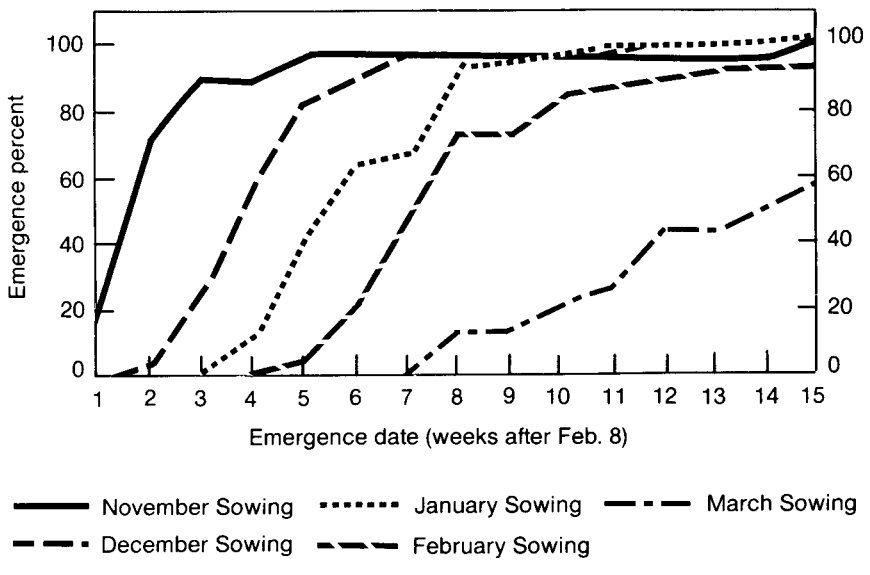

Figure 1—*Cumulative emergence rates of blue oak seedlings from acorns sown on different dates.*

Table 1—*First-year and second-year height growth of blue and valley oak seedlings from acorns sown in different months averaged for both species*

	Height growth (cm)	
Sowing date	1988	1989
November 10	28.0 a	21.0 a
December 11	25.0 a	16.2 c
January 12	27.7 a	18.0 bc
February 11	26.8 a	17.1 bc
March 10	19.9 b	15.5 c

In each column, values not followed by the same letter differ significantly ($P \leq 0.05$) by a least significant difference test.

Table 2—*First-year and second-year height growth of blue and valley oak seedlings averaged for all sowing dates*

	Height growth (cm)	
Species	1988	1989
Blue oaks	17.0 a	16.3 a
Valley oaks	33.9 b	18.9 b

In each column, values not followed by the same letter differ significantly ($P \leq 0.05$) by a least significant difference test.

There was little difference in 1989 bud burst date among any of the treatments. All seedlings that survived the first year began leafing out between March 20 and April 14. Averages among sowing dates and species varied by less than 3 days.

There were significant differences in first-year and second-year survival for both sowing dates and species. Since there were also significant interactions, the data are reported separately for each species (table

3). Survival was extremely high both years, averaging over 94% at the end of the first year, and 92% at the end of the second. In 1988, survival was significantly lower for the final sowing date for both species, and in 1989 for blue oak.

Discussion and Conclusions

Direct planting of acorns is a method of artificially regenerating oaks that has been used successfully in the South (4). However, it was not clear if this technique would work in California because theMediterranean-type climate and environment is harsh, with little or no rainfall between March and September. The results of this study indicate that direct seeding is a promising approach. Even without irrigation, fetilization, or augering, but with weed control, seedling survival after 2 years was over 90% and most plants had grown fairly vigorously.

It was clear from the study, however, that for both blue and valley oaks, sowing date can greatly impact field performance. Late season sowing resulted in delayed emergence, smaller height growth, and lower survival. To promote early emergence and rapid growth, seedlings should be sown early in the fall, after the first fall rains have soaked the soil. Early emergence and growth of seedlings should help them become established during favorable growing conditions, before soil moisture becomes limiting.

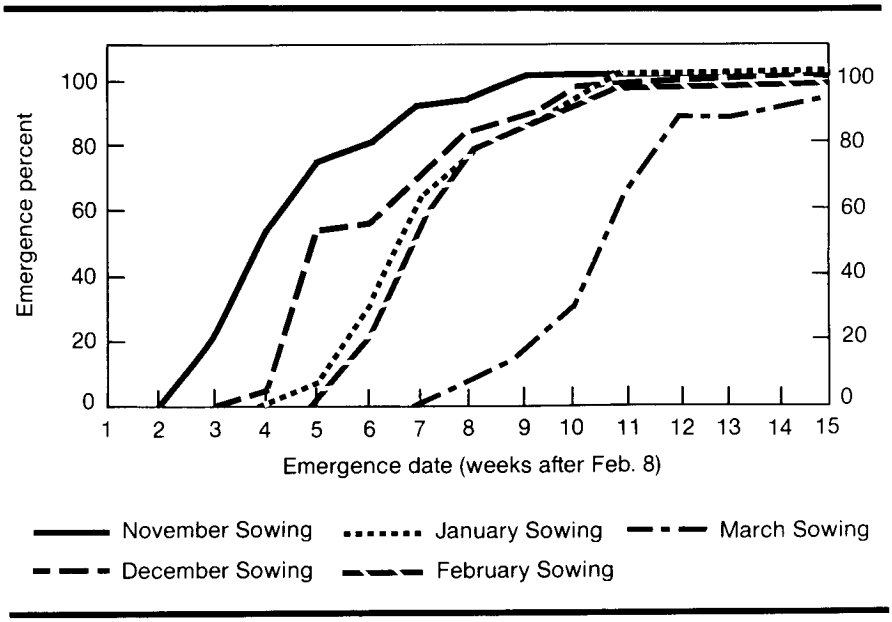

Figure 2—*Cumulative emergence rates of valley oak seedlings from acorns sown on different dates.*

Table 3—*Seedling survival from acorns sown in different months*

	Survival (%)	
Sowing date	1988	1989
Blue oak		
November 10	100 a	100 a
December 11	100 a	100 a
January 12	100 a	97 a
February 11	97 a	97 a
March 10	60 b	60 b
Valley oak		
November 10	100 a	100 a
December 11	97 ab	97 a
January 12	100 a	97 a
February 11	100 a	90 a
March 10	93 b	90 a

For each species, values in each column not followed by the same letter differ significantly ($P \leq 0.05$) by a least significant difference test.

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