Grafting California native oaks

William D. Tietje ❑ John H. Foott ❑ Elizabeth L. Labor

Preliminary results of grafting blue oak and valley oak scions to blue oak rootstock are encouraging. It appears that grafting of California native oaks has potential research and management applications.

Californians have become increasingly concerned about loss of native oak trees and their contribution to the state's natural beauty, wildlife habitat, and economy. During the past century, some oak species have not regenerated well in some parts of the state, especially blue oak (*Quercus douglasii*), valley oak (*Q. lobata*), and Engelmann oak (*Q. engelmannii*). Acorns and seedling oaks are often trampled or eaten by livestock. Since European settlement of California, deer (*Odocoileus hemionus*) and small rodents, which feed on acorns and seedlings, have increased in number. Mediterranean annual grasses, introduced in the mid-1700s, have gradually replaced native perennial bunch grasses. There is increasing evidence that Mediterranean annuals inhibit oak regeneration by competing for available space and soil moisture. Poor regeneration is only part of the problem: in the past 20 years, residential and commercial development has occurred on over 275,000 acres of oak rangeland, and use of native oak trees for firewood has increased.

The University of California and the California Department of Forestry and Fire Protection, under the auspices of the Integrated Hardwood Range Management Program, currently fund studies of several aspects of the oak problem. A principal focus is oak regeneration. On the site of a stump-sprouting study in southern San Luis Obispo County, a deer-proof fence was constructed around 1-1/2 acres of dense blue oak. Availability of an enclosed area protected from foraging by deer and livestock provided us with an opportunity to explore whether blue oak could be grafted successfully in oak rangelands.

Study area

The blue oak grafting site is on a private ranch in San Luis Obispo County about 6 miles southeast of Pozo, California. Average monthly temperatures range from about 43°F in January to 70°F in July. Average annual rainfall totals 20 inches. Typically, no rain occurs during May to October. Sandy-loam soils dominate the area.

Blue oak occupies many of the hillsides, and valley oak and coast live oak (*Q. agrifolia*) are scattered over the more moist valleys and gently rolling areas. Western sycamore (*Platanus racemosa*) and digger pine (*Pinus sabiniana*) are frequently interspersed with the oaks. Woody understory vegetation consists mostly of toyon (*Heteromeles arbutifolia*), manzanita (*Arctostaphylos* spp.), and poison oak (*Rhus diversiloba*). Forbs and annual grasses occupy the woodland floors and grassy open areas.

Methods

Because rainfall was low during the previous 3 years, blue and valley oak trees on the study site did not produce suitable scion wood for grafting in 1989. We therefore collected scion wood (current season's growth) on March 8 about 20 miles from the study area along a county road where runoff had provided better growing conditions. Scion wood, averaging 1/4 inch in diameter at the cut end and 2 feet in length, was taken from branches of small blue and valley oak trees. Immediately after harvest, the wood was put in a portable ice chest and, upon return from the field, stored for about a month in a refrigerator at 37°F.

Leaf flush occurred among blue oaks on the study site in early April. On April 7, just before grafting, six 3- to 8-inch-diameter blue oak rootstock trees were cut at about a 3-foot stump height, and 4-inch-long scions were cut from the scion wood collected in March. Each scion had several buds.

Blue oak scions were grafted onto three of the blue oak stumps and valley oak scions onto the three other stumps. Except for one blue oak stump grafted with two scions, three scions were grafted per stump. We used the modified bark grafting technique (as described in *Propagation of Temperate-zone Fruit Plants*, Leaflet 21103, by H. T. Hartmann and J. A. Beutel, UC Division of Agriculture and Natural Resources). After grafting, an asphalt sealant was applied to the cut surfaces of the stumps and scions to minimize water loss and potential infection.

Preliminary results

We measured scion shoots on June 23 and September 12 (table 1). In June, scion growth was present on two of the three stumps grafted with blue oak and on all three stumps grafted with valley oak. Two of eight blue oak scions had shoots, one on each of two stumps. One scion had two and

At the study site in San Luis Obispo County in September 1989, Farm Advisor Jack Foott examines an oak graft. Three valley oak scions had been grafted onto blue oak rootstock the previous April (below).

the other three shoots; the longest shoot was 6 inches. Five of the nine valley oak scions had shoots, one each on two of the stumps and all three on the third stump. Living scions had one to three shoots each, the longest of which was 15 inches.

In September, six of the seven scions alive in June were still alive; one valley oak scion

TABLE 1. Results of grafting blue oak scions onto blue oak rootstock (BB) and valley oak scions onto blue oak rootstock (VB) in southern San Luis Obispo County

Tree No.	Scion, rootstock*	Number of scions: Per stump	Number of scions: Alive (Jun/Sep)	Longest shoot (Jun/Sep)
				inches
73	BB	2	1/1	6.0/8.5
77	BB	3	0/0	—
87	BB	3	1/1	4.0/10.0
28	VB	3	3/3	14.0/14.5
54	VB	3	1/1	15.0/15.0
75	VB	3	1/0	1.0/—

* Stump diameters where grafted were 3 to 7 inches.

(tree No. 75) that had a 1-inch sprout in June had died. The other scion shoots appeared healthy and vigorous. Little scion growth occurred between June and September, except for a blue oak shoot that grew 2-1/2 inches (tree No. 73) and another that grew 6 inches (tree No. 87).

Conclusions

Based on our preliminary results, it appears that at least one native oak species, blue oak, can be grafted. The grafts have been monitored for only one season and sample size is small. Future incompatibility of the grafts may occur, especially with the valley/blue oak combination. Many years of study are needed to evaluate the grafting technique adequately.

If grafting of California's native oaks proves successful, it may have research and management applications. For example, seed orchards from genetically superior oak trees could be established; this is the most common use of grafting with conifer trees. Another research application of grafting would be detection of genetic variability by collecting scion wood throughout one oak species' distribution and grafting it to a mother tree (K. Rice, personal communication).

Grafting has possible uses in managing a firewood harvesting operation. Studies show that blue oak trees over 10 inches in diameter are poor sprouters. Further study may show that grafting could be used to regrow some of the larger trees cut for firewood. Also, grafting genetically superior scions onto rootstock may result in faster growth and more rapid establishment of a stand of trees.

Because of these potential applications, grafting of California native oaks is a suitable subject for continued research. The following studies are planned: (1) increase sample size of the grafting trial to 20 blue/blue and 20 valley/blue oak grafts; (2) graft onto trees that are poor sprouters (those over 10 inches in diameter); and (3) graft valley oak scions onto coast live oak rootstock.

Our intention in the 1989 experiment was to test the feasibility of grafting blue oak. Preliminary results are encouraging. With continued study, the usefulness and application of grafting California native oaks can be more fully assessed.

William D. Tietje is Natural Resources Specialist/Central Coast, Department of Forestry and Resource Management, University of California, Berkeley; John H. Foott is Farm Advisor; and Elizabeth L. Labor is Extension Horticulture Student Intern. All three are stationed at the UC Cooperative Extension office, San Luis Obispo County. *The authors thank Jim Sinton, Avenales Ranch, for permitting access to his land for study purposes.*

Control of two avocado mite pests

J. Blair Bailey ❑ Kirk N. Olsen

Several materials were tested for possible use when avocado brown mite and sixspotted mite populations build up, threatening to cause extensive leaf drop. Sulfur was effective against avocado brown mite. Others, at present unregistered for this use, were effective against both mites.

Avocado brown mite and the sixspotted mite are the two most common mite pests of California's 75,000 acres of commercial avocados. Generally, outbreaks of avocado brown mite occur in areas with a coastal or intermediate climate in southern California. Sixspotted mite infestations have been largely confined to lemons and avocados growing in the coastal areas of Santa Barbara and San Luis Obispo counties. In most instances of sixspotted mite infestations on avocados, the grove has been near an infested lemon grove. Highest populations of both mite species are usually seen during late summer and early autumn. Both mites produce webbing on leaf surfaces.

Avocado brown mite, *Oligonychus punicae* (Hirst), is found on the upper sides of avocado leaves. Feeding injury begins on the midrib and extends out along the lateral veins, eventually covering the entire upper surface. When populations are very high, this mite will move onto lower leaf surfaces. Feeding removes chlorophyll, causing leaves to turn a brownish color, commonly referred to as bronzing. The avocado brown mite also removes chlorophyll from the surface of avocado fruit, which sometimes results in downgrading by packinghouses.

Studies have shown that bronzing reduces transpiration and photosynthesis rates (*California Agriculture*, May-June 1982). Leaves can recover from this injury, but may not if the infestation persists. Extensive leaf drop is likely to occur if avocado brown mite population densities reach an average of 75 to 100 adult females per leaf for short periods, or when densities remain at 50 females per leaf for several weeks.

The sixspotted mite, *Eotetranychus sexmaculatus* (Riley), is found on the undersides of leaves and is not confined to any particular area. In high populations, however, they seem to prefer areas immediately adjacent to the midrib and larger lateral veins. Feeding causes removal of chlorophyll and development of grayish spots or blisters. Leaf drop occurs when population densities reach an average of 5 to 10 adult male and female mites per leaf.

Only sulfur or narrow range 415 (NR-415) spray oil are currently registered for use to control mites on bearing avocados in California. The use of NR-415 spray oil is restricted to the Hass variety of avocado. However, neither material has been considered entirely effective for controlling either pest.

In search of more reliable materials, we tested six products in two field trials. Products tested were Plictran (cyhexatin), Omite (propargite), Vendex (fenbutatin oxide), flowable sulfur, insecticidal soap, and NR-415 spray oil. The first three materials are well-known acaricides used on many food and ornamental crops. Insecticidal soap is safe to use around human habitation, and other researchers have reported that it gives fair to good control of other mite species. Sulfur and NR-415 spray oil were included for comparison.

TABLE 1. Control of avocado brown mite (ABM) with acaricides, Santa Barbara County, September-October 1982

Treatment and formulation/ 100 gallons	Average number mites/ 20 leaves*◊	
	ABM	Predacious
Omite 30W, 24 oz	0.8 a	0.2 a
Flowable sulfur, 20 oz	0.8 a	6.4 bc
Plictran 50W, 6 oz	1.4 a	0.2 a
Vendex 50W, 6 oz	3.6 a	9.4 c
Insecticidal soap, 3 gal	17.0 b	2.4 ab
NR-415 spray oil, 5 qt	21.4 b	5.4 bc
Untreated check	328.2 c	28.0 d

* 7 days after treatment
◊ Means followed by the same letter are not significantly different ($P = 0.05$, Duncan's Multiple Range Test).

TABLE 2. Control of sixpotted mite (SSM) with acaricides, Santa Barbara County, September-October 1982

Treatment and formulation/ 100 gallons	Average number mites/20 leaves, days posttreatment*		
	SSM		Predacious
	7	21	7
Plictran 50W, 6 oz	28.6 a	28.8 a	0.4 a
Omite 30W, 24 oz	58.4 ab	157.4 b	2.4 ab
Insecticidal soap, 3 gal	84.4 b	222.8 bc	2.4 ab
Flowable sulfur, 20 oz	95.4 b	205.2 bc	7.6 bcd
Vendex 50W, 6 oz	149.8 b	221.6 bc	13.8 d
NR-415 spray oil, 5 qt	169.8 b	259.6 bc	8.0 bc
Untreated check	375.8 c	353.6 c	11.2 cd

* Means followed by the same letter are not significantly different ($P = 0.05$, DMRT).