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ARTIFICIAL REGENERATION OF BLUE AND VALLEY OAK IN CALIFORNIA

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ABSTRACT

Several species of white oak are not regenerating well in many areas of California. Suspected elements of poor valley oak (Quercus lobata) and blue oak (Q. douglasii) regeneration are being studied in three regions using artificial regeneration techniques. Plantings of acorns and nursery stock have been made within deer-proof exclosures to examine the impacts of weed competition, fertilization, and small mammals and insects. Results suggest weed control and protection from small mammals and insects will be necessary for successful artificial regeneration of blue and valley oak in many areas of the state.

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INTRODUCTION

In certain parts of the state, white oaks, represented by blue oak (Quercus douglasii), valley oak (Q. lobata), and Engelmann oak (Q. engelmanii), are not regenerating well (Pillsbury et al., 1983; Mayer et al., 1986). Failure to regenerate is poorly understood, but it is related to long-term trends in climate, fire history, invasion of non-native grasses, cultivation, browsing of cattle and wildlife, and movement of people into wildland areas.

Compounding this problem is the harvesting of hardwoods, including the oaks, for fuel wood and other purposes. The extent of this harvest is generally unknown, but available information indicates the harvest of hardwoods is substantial and growing (Pillsbury et al., 1983).

Public pressure to protect the values represented by the oaks and other hardwoods is increasing (Pillsbury et al., 1983). Development of information on restocking of oak through artificial regeneration is needed to justify and support policy decisions relative to management of oaks.

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Procedures for propagation, culture, and management of oaks in controlled environments have been developed (Chan et al, 1977; Lobel and George, 1983; Schettler and Smith, 1980; Schopmeyer, 1974). However, as has been pointed out, regeneration under natural conditions is not good in many situations. Causes for this failure are poorly understood, but acorn and seedling predation by mammals, birds, and insects has been identified as a specific problem (Griffin, 1980; Griffin, 1977).

Research is currently being conducted to investigate selected aspects of the artificial regeneration of blue and valley oak. It is supported by the Environmental License Plate Fund administered by The Resources Agency of California. Initial results were published in 1987 (Adams et al., 1987). Information describing results from the past two seasons is summarized in this presentation.

OBJECTIVES

1. Evaluate the impacts of selected environmental factors on artificial oak regeneration in several regions of California including the north coast (Mendocino County), the south-central coast (San Luis Obispo County), and the eastern Sacramento Valley north of San Francisco Bay (Yuba County).

2. Determine the impacts of herbaceous competition, fertilizer, rodents, and insects on artificial regeneration of blue and valley oak.

3. Develop strategies to combat negative impacts on artificial regeneration.

METHODS

1. All studies are conducted within deer-proof exclosures away from canopy effects on oak-grassland range supporting mature stands of blue or valley oak.

2. Used are both fall planted acorns and 2-3 month old nursery stock transplanted in winter, the latter used where weed control is practiced.

3. Two and three factor factorial experiments organized in randomized complete blocks have been employed to identify the effects of weed control (acorns), fertilization, and rodent or insect protection.

4. As a source of fertilizer, first year experiments initiated in 1985-86 used Osmocote® 18-6-12 (8-9 month release) buried beneath individual acorns and transplants.

5. Rodent protection is provided by Foregon® rigid plastic protectors, and window screen cages are used to protect against both rodents and grasshoppers.

6. Weed control is achieved by use of a systemic herbicide, glyphosate (Roundup), and a soil-active material, atrazine. These materials are used post-plant on acorns before emergence and pre-plant (glyphosate) or post-plant (atrazine) on transplants.

RESULTS

Directly Seeded Acorns

Emergence and Survival

1. The combined effects of annual weed competition and fertilizer significantly reduced emergence and survival of blue oaks in Yuba County (Table 1).

2. Competition from annual weeds and use of fertilizer does not always reduce emergence of blue oaks (Table 1), but survival of blue oak seedlings in San Luis Obispo County has been significantly greater without fertilizer (Table 1). Weeds played no significant role in survival at this location.

3. Annual weeds and fertilizer have combined to significantly reduce survival of valley oak seedlings in San Luis Obispo County (Table 1).

Vigor

1. While fertilizer has had no effect on seedling vigor, i.e., percent of plants with leaves, in Yuba County, the number of blue oak seedlings with leaves growing here and in Mendocino County is significantly greater where plants are protected from grasshoppers and weed control is used (Table 2).

2. Lack of grasshopper protection combined with absence of weed control has had a dramatic effect on defoliation of valley oak in Mendocino County (Table 2).

3. In San Luis Obispo County, rodent protection significantly increased the number of blue oak seedlings with leaves but did not significantly influence valley oak performance (Table 2).

Growth

1. Fertilizer and grasshoppers (Melanoplus devastator) have significantly affected growth of blue oak seedlings in Yuba County (Table 3), and in Mendocino County, weeds and grasshoppers have significantly reduced growth of blue and valley oak seedlings (Table 3).

2. Rodents, primarily rabbits (Sylvilagus spp.), have been a major problem in San Luis Obispo County; they have significantly reduced growth of both blue and valley oak seedlings (Table 3).

Nursery Stock

Survival and Growth

1. Use of fertilizer significantly reduced survival of valley oak transplants in Mendocino County, but absence of screen protection did not impair growth (Table 4).

2. In San Luis Obispo County, absence of rodent protection has seriously reduced survival of blue oak transplants over a two year period (Table 5).

3. Both fertilizer and rodents have significantly reduced height of blue oak transplants during the past two seasons in San Luis Obispo County (Table 5).

4. Blue oak nursery stock planted in San Luis Obispo County during the 1986-87 season has been eliminated by rodents where unprotected (Table 5).

CONCLUSIONS

1. Oak regeneration in California from artificially seeded acorns and from nursery stock faces many problems.

2. Competition from annual weeds (moisture stress) may be the most important problem.

3. Locally, insects (grasshoppers) and small mammals (rabbits, squirrels, and gophers) are a significant source of mortality.

4. Results from the current project suggest weed control and protection from identified predators will be necessary for successful artificial regeneration in many areas of California.

Table 1. Percent emergence and survival of 1985-86 blue and valley oak seedlings and percent emergence of 1986-87 seedlings from directly seeded acorns in three counties. Survival measured in spring, 1987 (1985-86 Seeding) as a percent of emergence.

	WEED CONTROL[1,2]		FERTILIZER[1,2]		WEED CONTROL X FERTILIZER INTERACTION[1,2]			
					WEED CONTROL		NO WEED CONTROL	
MEASURE	YES	NO	YES	NO	FERT.	NO FERT.	FERT.	NO. FERT.
UC SIERRA FIELD STATION, YUBA COUNTY								
Blue Oak (1985-86 Seeding)								
Emergence	81A	32B	47B	67A	83A	79A	13C	53B
Survival	59A	13B	27B	41A	59A	58A	5C	14B
UC HOPLAND FIELD STATION, MENDOCINO COUNTY								
Blue Oak (1986-87 Seeding)								
Emergence	58A	46A						
Valley Oak (1986-87 Seeding)								
Emergence	30A	27A						
CANYON RANCH, SAN LUIS OBISPO COUNTY								
Blue Oak (1985-86 Seeding)								
Emergence	70A	59A	56A	73A				
Survival	15A	16A	6B	30A				
Blue Oak (1986-87 Seeding)								
Emergence	48							
LOPEZ LAKE, SAN LUIS OBISPO COUNTY								
Valley Oak (1985-86 Seeding)								
Emergence	72A	58A	56B	74A				
Survival	44A	39A	53A	31B	38B	50A	24C	56A

[1]Values with the same letter for a given location are not significantly differenct ($P<0.05$) by LSD separation.

[2]Percent of 100 acorns per treatment for emergence with survival a percent of emergence.

Table 2. Vigor (% green) of 1985-86 and 1986-87 blue and valley oak seedlings produced by direct seeding acorns in three counties. Measurements made in fall, 1987.

WEED CONTROL[1,2]		FERTILIZER[1,2]		PROTECTION[1,3]		WEED CONTROL X SCREEN PROTECTION INTERACTION[1,3]			
						WEED CONTROL		NO WEED CONTROL	
YES	NO	YES	NO	YES	NO	PRO.	NO PRO.	PRO.	NO. PRO.
UC SIERRA FIELD STATION, YUBA COUNTY									
Blue Oak (1985-86 Seeding - Weed Control Treatments)									
30A	26A	67A	-0-B						
UC HOPLAND FIELD STATION, MENDOCINO COUNTY									
Blue Oak (1986-87 Seeding)									
75A	37B			90A	18B				
Valley Oak (1986-87 Seeding)									
34A	19B			77A	-0-B	90A	-0-C	61B	-0-C
CANYON RANCH, SAN LUIS OBISPO COUNTY									
Blue Oak (1985-86 Seeding - Weed Control Treatments)									
				98A	49B				
Blue Oak (1986-87 Seeding)									
				87A	57B				
LOPEZ LAKE, SAN LUIS OBISPO COUNTY									
Valley Oak (1985-86 Seeding - Weed Control Treatments)									
				88A	83A				

[1]Values with the same letter for a given location are not significantly different ($P<0.05$) by LSD separation.

[2]Percent of less than 100 surviving plants per treatment.

[3]Percent of less than 50 surviving plants per treatment.

Table 3. Height in inches of 1985-86 and 1986-87 blue and valley oak seedlings produced by direct seeding acorns in three counties. Measurements made in fall, 1987.

	WEED CONTROL[1]		FERTILIZER[1]		SCREEN PROTECTION[1]	
	YES	NO	YES	NO	YES	NO
UC SIERRA FIELD STATION, YUBA COUNTY						
Blue Oak (1985-86 Seeding - Weed Control Treatments)						
			2.8	1.9	2.9	1.8
UC HOPLAND FIELD STATION, MENDOCINO COUNTY						
Blue Oak (1986-87 Seeding)						
	2.6	1.5			2.9	1.2
Valley Oak (1986-87 Seeding)						
	2.0	1.5			2.0	1.4
CANYON RANCH, SAN LUIS OBISPO COUNTY						
Blue Oak (1985-86 Seeding - Weed Control Treatments)					1.4	0.5
Blue Oak (1986-87 Seeding)					1.6	0.4
LOPEZ LAKE, SAN LUIS OBISPO COUNTY						
Valley Oak (1985-86 Seeding - Weed Control Treatments)					3.8	2.8

[1]Values presented are significantly different ($P<0.05$).

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