

# EFFECTS OF LEAF LITTER DEPTH ON ACORN GERMINATION

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## INTRODUCTION

Lack of advanced regeneration is generally considered to be the primary factor associated with the failure to regenerate oak particularly on medium to high quality sites. This is generally considered to be a function of the limited light environment often associated with undisturbed canopies on mesic sites. However, other factors such as a relatively thick litter associated with these types of sites has been shown to increase the desiccation of acorns during the initial stages of radical immersion and thus potentially reduce the number of seedlings established. This study was designed to test a litter reduction treatment (prescribed fire) on the successful germination and establishment of selected upland oak species.

## METHODS

The study was located at Robinson Forest, the University of Kentucky research and demonstration forest located in the Cumberland Plateau Physiographic Province in southeastern Kentucky. Two upland oak stands, approximately 3 acres in size, on slopes of opposing aspects were used in this study. One stand was located on a predominately southwest facing slope (black oak site index=65ft) and the other stand was located on a northeast facing slope (black oak site index=90ft). Ten study plots (9 m<sup>2</sup>) were randomly located in each stand. The study incorporated a split plot design where each plot was split into a untreated subplot and a treated (prescribed burned) subplot. Each subplot was divided into 4 species plots. One of four oak species (*Quercus rubra*, *Q. alba*, *Q. prinus*, and *Q. coccinea*) were randomly assigned to each of the 4 species plots and 20 acorns of that species were planted in October of 1997. In the untreated subplots acorns were placed on the existing litter directly prior to leaf fall. Acorns were protected from vertebrate predation and the current years leaf deposition covered the acorns. To avoid altering the environment around the acorns predation protection was removed after leaf deposition. Treated subplots were established by burning directly prior to planting in October. The burn was sufficient to remove the majority of the litter. Acorns were then dropped on the exposed soil, or in some instances charred organic matter. They were protected from predation and leaf deposition allowed to cover the acorns at which time protection was removed. A 565 cm<sup>2</sup> sampling frame was used to collect litter samples were collected from five areas at the edge of each subplot. Samples were dried and pre-treatment litter mass

determined. Within the burned subplots litter samples were also collected after leaf fall to determine litter cover over the acorns. The litter samples were used to determine pre-treatment litter mass (kg/ha) and post-treatment average litter mass for each subplot. Plots were evaluated in June. The percentage of acorns which developed seedlings in each species block was determined and subjected to normalization using an arc sin transformation for analysis using the Wilcoxon two sample t-test to determine treatment effects for the data pooled over sites and species as well as species within a site.

## RESULTS

Burning resulted in significantly higher seedling establishment percent for some species. Overall seedling establishment averaged 1.32 percent on burned plots and 1.04 percent on unburned plots. These values are similar to other reported establishment percent for years where acorn production is average or below average. Establishment rates have been shown to be as high as 10 percent for years when bumper crops occur. A more pronounced and significant difference ( $p=0.0297$ ) was found on the northeast site compared to the southwest site. Mean seedling establishment percent pooled over all species on the northeast site was 1.38 on burned plots and 0.62 on unburned plots. Mean seedling establishment percent pooled over all species was not significantly different ( $p>0.05$ ) between treatments on the southwest site (unburned = 1.41 percent and burned = 1.25 percent).

Northern red oak exhibited significantly higher ( $p=0.0006$ ) establishment percent in burned plots (mean=2.0) on the northeast site compared to unburned plots (mean=0.30) (Table 1). Chestnut oak also exhibited significantly higher ( $p=0.02$ ) establishment percent on burned plots (mean=2.0) compared with unburned plots (mean=0.50). No treatment differences were exhibited by white oak (which totally failed on the northeast site) or scarlet oak on either site.

This study indicates that prescribed burning may represent a viable treatment for increasing the development of advanced regeneration of chestnut oak and northern red oak on intermediate and high quality upland sites. While the primary effect of the burning was believed to be on litter thickness it may have also changed other factors which could have effected germination and establishment. The

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burning may have influenced population densities of predatory insects which might feed on acorns and emerging radicles or altered the potential of infection by pathogens. Regardless, this study indicates that the use of

properly timed prescribed burning should be investigated as an aid in establishing oak advanced regeneration on mesic sites.

Table 1—*Quercus* seedling establishment as influenced by prescribed fire

	<i>Q. coccinea</i>	<i>Q. prinus</i>	<i>Q. alba</i>	<i>Q. rubra</i>
----- Percent -----				
Southwest slope				
Burned	1.25 (0.55) <sup>1</sup>	1.88 (0.63)	0.63 (0.06)	1.26 (0.56)
Unburned	1.88 (0.63)	2.50 (0.65)	0.61 (0.06)	1.89 (0.90)
Northeast slope				
Burned	1.50 (0.53)	2.00 <sup>a</sup> (0.56)	0	2.00 <sup>a</sup> (0.76)
Unburned	1.50 (0.53)	0.50 <sup>b</sup> (0.34)	0	0.30 <sup>b</sup> (0.03)

<sup>1</sup> Values represent mean seedling establishment percent (standard errors). Values with different letters represent a significant different ( $p < 0.01$ ) between treatments using Wilcoxon two sample t-test.