RELEASING RED OAK REPRODUCTION USING A GROWING SEASON APPLICATION OF OUST

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Abstract—In most cases, newly harvested upland oak stands contain sufficient numbers of red oak stems to form a fully stocked oak stand in the future. Unfortunately, many stands will not reach full stocking of oak due to intense competition from other non-oak reproduction. There are few feasible options to release established oak reproduction from other broadleaf woody or non-woody vegetation. This study assessed the year 1 results of an over-the-top application of the herbicide Oust (0.2 kg/ha) during the growing season to reduce the competitiveness of non-oak species. The first year after treatment, Oust reduced the total height and diameter of non-oak species by about 20 percent without affecting mortality or growth of red oak stems. The application of Oust over the top of actively growing mixed oak stand, while not a labeled use, does show promise as an effective and operationally feasible release treatment.

INTRODUCTION

The intent of this work is to explore an efficient means to effectively enhance the survival and productivity of red oak (*Quercus rubra* L. and *Q. velutina* Lam.) reproduction on moderately productive cutover stands in the Ozark highlands. Following harvesting, a substantial decrease of red oak composition has been noted in stands that previously supported large numbers of mature oak stems. Regeneration failures from the standpoint of oak stems have resulted from their slow growth and poor survival during the first decade relative to species like red maple and black cherry but typically not from a lack of new germinants. Most stands have several thousand oak seedlings per ha following harvest (Kays and others 1988). However, even 2,200 to 9,900 oak stems/ ha have been reported inadequate because most seedlings were too small to compete with other woody and herbaceous species (Arend and Scholz 1969). Current recommendations for naturally regenerating red oak species on good sites are based on the paradigm that several hundred large stems (>1.2 m tall) of advance regeneration are needed before the overstory should be harvested (Johnson and others 2002).

The recent oak decline in northern Arkansas, facilitated in part by a red oak borer (*Enaphalodes rufulus* Haldeman) epidemic, has resulted in stands with significant mortality to mature red oak growing stock. This decline has led to many stands being salvage logged without any consideration as to whether stand conditions were favorable (i.e., adequate numbers of large oak advance reproduction) to regenerate a new stand that will have a significant component of red oak species. Subsequent post-harvest inventories show that the canopy gaps produced by individual tree mortality and salvage operations have regenerated new cohorts of seedlings that are dominated by less desirable dogwood (*Cornus florida* L.), blackgum (*Nyssa sylvatica* Marsh.), and black cherry (*Prunus serotina* Ehrh.) stems that are at a competitive advantage over the initially slow growing northern red oak (Heitzman 2003). Without the large advance regeneration purportedly required for maintaining the red oak composition present prior to the oak declines beginning in 1999, these new stands will have significant reductions in their future oak component. New techniques are needed to reverse these undesirable stand conditions that fell outside of the current regeneration requirements for red oak stands.

Large growth responses to vegetation control treatments that release newly regenerated oak stems from both woody and herbaceous competition are possible (Schuler and Robison 2006). However, the issue that has plagued natural and plantation hardwood forest management has been the lack of species-specific herbicides, such as those readily available for pines (e.g., imazapyr) (Schuler and others 2004). Thus far, these hardwood-specific herbicides are only labeled for a few plantation-grown species such as sweetgum (*Liquidambar styraciflua* L.) and cottonwood (*Populus deltoides* Bartr. ex Marsh.).

Oust is typically used as a pre-emergent herbicide in loblolly pine (*Pinus taeda* L.) stands and over dormant hardwood stems. Herbicide screening trails have identified red oak resistance to post-emergent, over-the-top applications of Oust during the summer growing season (Ezell and Nelson 2001). Other studies have shown that similar applications of Oust were toxic to species like black cherry, white ash (*Fraxinus americana* L.), and many herbaceous species when applied for fern control in natural regeneration in PA (Horsley and others 1992). The focus of this study was to determine whether Oust applied over-the-top of red oak reproduction during the growing season can kill or severely reduce the competitiveness of competing vegetation (other hardwood stems), while still affording red oak tolerance.

METHODS

This study was conducted on an upland mixed oak stand in Independence County, AR that was partially harvested three years prior to treatment. Eight treatment plots were delineated in areas with large canopy gaps that facilitated abundant reproduction. Treatment plots measured 6.1 by 12.2 m. Two treatments were randomly assigned to four untreated control plots and four treated plots that received 0.2 kg/ha of Oust XP applied as a broadcast spray from a 1.8-m boom during May 2006.

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On each treatment plot, 20 to 30 red oak stems were individually tagged, and groundline diameter and total height were recorded. Through the center of each treatment plot, a 2.4 by 12.2 m measurement strip was delineated and permanently monumented for the purposes of quantifying oak seedlings and non-oak woody stems. Total heights of all stems within the center strip were tallied by species, including the individually tagged red oak stems. Individual oak and non-oak stems within the measurement strip were inventoried immediately prior to the application of treatments and again at the end of the first growing season (fall 2006) following the application of treatments.

Oak and non-oak species were compared by treatment and measurement period. Analysis of variance was used to detect significant differences at alpha =0.10.

RESULTS AND DISCUSSION

The goal of this study was to assess the ability of Oust to reduce the competitive status of non-oak stems without affecting the growth and survival of red oak seedlings. One growing season after treatment, non-oak stems treated with Oust had 30 cm shorter total heights compared to untreated stems (P=0.066) (table 1). Stem density changed markedly by the end of the first growing season. Oust treated plots had 22 percent fewer stems by the end of the growing season, while stem density was reduced by 7 percent on the untreated plots. However, differences in stem density between control and Oust treatments and between beginning and the end of year measurements within each treatment were not significant (P>0.10).

The non-oak group included numerous species. Certain species are known to be more sensitive to Oust than others. Horsley and others (1992) demonstrated that black cherry and white ash were killed or severely impacted by early summer applications of 0.13 kg/ha of Oust, whereas established red maple were essentially tolerant. For this study, treated and untreated plots had few differences in relative species composition within each treatment (table 2). Only redbud (P=0.097) and the miscellaneous group (P=0.098) for the control treatment showed significant changes from the beginning of the experiment to the end of the first growing season. However, the power to detect statistical differences was limited due to low representation within many species/species groups.

For total height, no statistical differences were detected between control and Oust treated stems at the initiation of the study (table 3). By the end of the first year, differences between treatments for various species were beginning to emerge. For example, stem height of elm species group was 30 percent lower than on untreated controls (P=0.024) (table 3). Sweetgum heights were also significantly lower on the Oust treated plots compared to the untreated controls (P=0.086), but these were comparing only a few stems per treatment (table 2).

Red oak stems on both treatments had minimal mortality. At the rate applied, a May application of Oust does not cause death to established stems. Mortality ranged from three to four percent for untreated and treated stems. This result was corroborated by studies in naturally regenerated hardwood stands in PA (Horsley and others 1992) and planted stands in MS (Ezell and Nelson 2001).

After one year, no significant differences were detected for red oak height or diameter between treatments (table 4). While not significant, trends did show red oaks having larger increases in height and diameter growth on Oust treated plots versus the control plots. When red oak stems were separated into <100, 101 to 200, and 201 to 300 cm height classes, groundline diameter for the smallest size class improved by 34 percent on the Oust treated plots (P=0.082, fig. 1). No other significant differences were noted among the other size classes for height (fig. 2) or diameter. The lack of notable differences after one growing season is not unexpected. Relative to many intolerant species, red oaks have a much more conservative growth strategy. Responses to release, especially on younger stems, may take several years to develop (Schuler and Robison 2006).

CONCLUSIONS

Despite our best silviculture there will always be instances where ameliorative treatments are needed. Regeneration is a process somewhat controlled by chance. While there are ways to improve the probability of success, failures do occur, especially if one is interested in particular species. For this study, an unforeseeable pest outbreak resulted in a stand being regenerated without any attempt to control species composition, leaving red oak reproduction at a competitive disadvantage. Few, if any, cost-effective release treatments are available for oak seedlings and saplings. The use of Oust to release oak species from both woody and non-woody competition does appear to have promise. Some non-oak species had reduced stem densities and reduced growth compared to untreated plots. Mortality of treated red oak stems was equivalent to the untreated stems, which was almost nonexistent. The red oak stems treated with Oust will have to be monitored over several years to determine whether Oust can be considered a positive treatment for releasing established reproduction, but the trends indicate

Table 1—The response of non-oak species to a single growing season application of Oust

Treatment	Initial height (cm)	Year 1 height (cm)	Initial stems/ ha	Year 1 stems/ acre
Control	122.7	156.2*	14,126	13,119
Oust	107.7	126.1	16,482	12,782

* = A significant difference (alpha=0.10) between treatments .

Table 2—Species composition of non-oak species (percent of total) prior to the initiation of treatments (May 2006) and at the end of the first growing season (fall 2006)

		Control		Oust	
Common name	Scientific name	Pre-treatment	Year 1	Pre-treatment	Year 1
white ash	*Fraxinus americana*	26.9	27.3	27.3	17.6
black cherry	*Prunus serotina*	8.5	7.0	2.2	0.8
French-mulberry	*Callicarpa americana*	4.6	7.0	0.0	0.0
red buckeye	*Aesculus pavia*	8.5	8.9	4.4	6.3
elm	*Ulmus* spp.	10.2	8.1	31.4	31.3
hackberry	*Celtis occidentalis*	10.9	4.1	3.6	3.6
hickory	*Carya* spp.	10.4	8.0	3.2	4.9
eastern redcedar	*Juniperus virginiana*	6.5	7.9	4.0	5.0
persimmon	*Diospyros virginiana*	0.0	4.5	4.5	7.8
privet	*Ligustrum* sp.	3.5	1.6	0.0	0.5
redbud	*Cercis Canadensis*	6.4*	0.8	2.5	1.5
red maple	*Acer rubrum*	0.8	2.5	0.0	0.8
sweetgum	*Liquidambar styraciflua*	0.0	1.8	4.8	5.9
miscellaneous		2.8*	11.5	12.2	14.1

Columns may not add to exactly 100 percent due to rounding.
* = significant difference (alpha=0.10) between measurement periods within species and treatment.

Table 3—Mean total stem height (cm) for various species

	Pre-treatment		Year 1	
Species/ species group	Control	Oust	Control	Oust
white ash	121.0	93.2	124.0	141.1
black cherry	134.2	178.0	143.7	152.0
red buckeye	105.2	114.1	132.7	112.8
elm	105.4	114.8	191.2*	134.0
hackberry	132.5	124.1	154.3	138.3
hickory	124.1	114.1	167.8	116.4
eastern redcedar	144.3	99.9	162.0	109.0
persimmon	-	213.7	256.9	202.6
redbud	95.0	118.1	168.0	90.3
red maple	152.5	-	174.3	135.0
sweetgum	-	70.3	258.0*	85.7

* = A significant treatment difference (alpha=0.10) within a measurement period.

Table 4—The response of red oak stems to a single growing season application of Oust

Treat-ment	Initial height (cm)	Year 1 height (cm)	Initial diameter (mm)	Year 1 diameter (mm)
Control	136.1	151.7	13.1	17.9
Oust	142.7	161.0	14.7	20.9

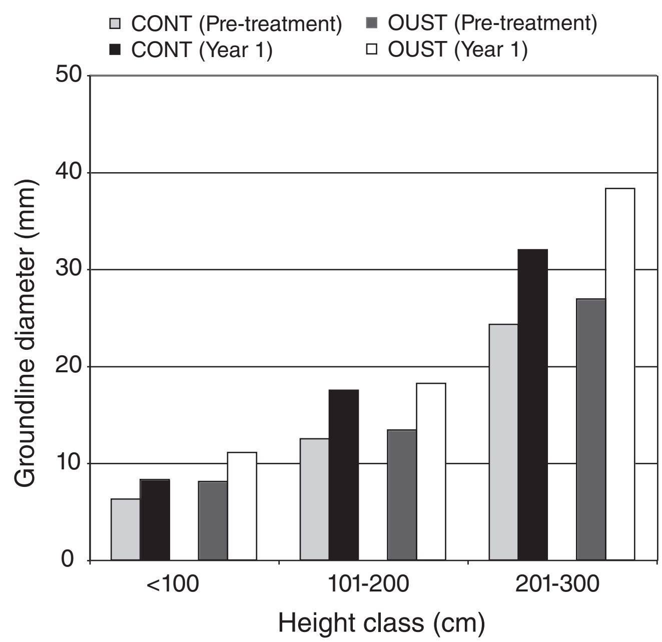

Figure 1—Diameter growth of various size classes of red oak seedlings treated with a growing season application of Oust.

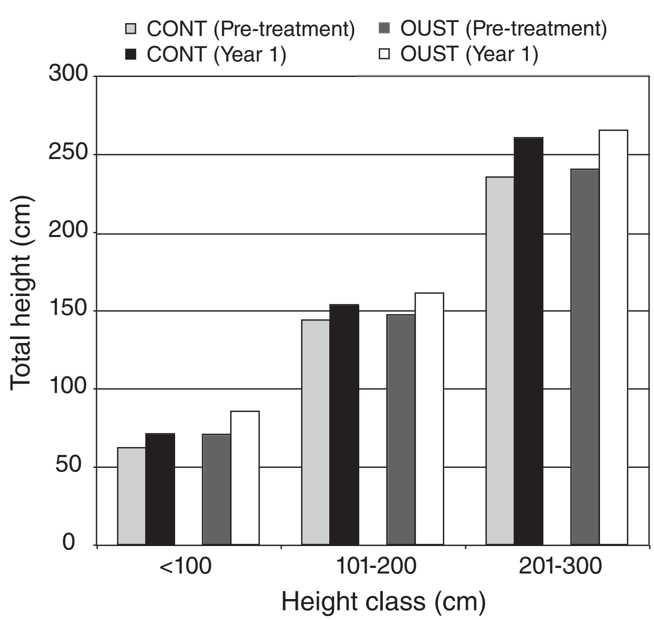

Figure 2—Height growth of various size classes of red oak seedlings treated with a growing season application of Oust.

that 0.2 kg/ha of Oust XP is effective. The current limitation of this treatment is that Oust is not labeled for a growing season release of naturally regenerated hardwood seedlings.

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LITERATURE CITED

Arend, J.L.; Scholz, H.F. 1969. Oak forests of the Lake States and their management. Res. Pap. NC-31. U.S. Forest Service, North Central Forest Experiment Station, St. Paul, MN.

Ezell, A.W.; Nelson, L. 2001. Weed control and crop tolerance after preemergent and postemergent applications of sulfometuron in oak (*Quercus* spp.) plantations. Weed Technology. 15: 585-589.

Heitzman, E. 2003. Effects of oak decline on species composition in a northern Arkansas forest. Southern Journal of Applied Forestry. 27: 264-268.

Horsley, S.B.; McCormick, L.H.; Groninger, J.W. 1992. Effects of timing of oust application on survival of hardwood seedlings. Northern Journal of Applied Forestry. 9: 22-27.

Johnson, P.S.; Shifley, S.R.; Rogers, R. 2002. The Ecology and Silviculture of Oaks. CABI Pub., Cambridge, MA: 503 p.

Kays, J.S.; Smith, D.W.; Zedaker, S.M. [and others]. 1988. Factors affecting natural regeneration of Piedmont hardwoods. Southern Journal of Applied Forestry. 12: 98-101.

Schuler, J.L.; Robison, D.J. 2006. Stand development and growth response of 1 to 6 year-old natural upland hardwoods to silvicultural treatments. Forest Ecology and Management. 232: 124-134.

Schuler, J.L.; Robison, D.J.; Quicke, H.E. 2004. Assessing the use of chopper herbicide for establishing hardwood plantations on a cutover site. Southern Journal of Applied Forestry. 28: 163-170.