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The Use of Hexazinone to Control Turkey Oak Competition in a Young Longleaf Plantation

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Abstract: The use of hexazinone in a longleaf stand is an effective method to control turkey oaks that compete for resources and shade the forest floor. Studies show competition control increases tree growth and allows the understory plant community to expand and flourish. In our demonstration study the broadcast application of hexazinone increased total average tree height in the treated plots by 9.1 feet representing a 24% gain over the untreated trees. Average diameter at breast height (DBH) was 2.4-inches greater for the treated plots. Hexazinone application caused positive changes to the understory plant community resulting in substantial increases in the number and abundance of grasses and forbs present. A one-time application of hexazinone is a good management option to maximize timber production volume, facilitate pinestraw raking or to jumpstart an understory restoration project.

Introduction

Many degraded longleaf sites in the sandhills regions of North Carolina are invaded by turkey oak and other scrub oaks following a timber harvest or planting failure. Fire or mechanical removal is often not effective to control these thick bark scrub oaks, as they sprout vigorously if top-killed by fire or if cut by a saw. Herbicide treatment is a proven method to reduce the number encroaching hardwoods and at the same time favor expansion of the understory herbaceous layer. A one-time application of herbicide can be used to compliment or jumpstart restoration efforts that includes a prescribed burn program. Control of competing woody vegetation is also effective to increase timber growth and yield, Pinestraw producers want to eliminate hardwood brush and trees to produce debris free bales and improve raking efficiency.

Hexazinone is a broad spectrum, water soluble herbicide whose mode of action is photosynthesis inhibition. Hexazinone controls some grasses, many broadleaf forbs and some woody species. Oaks, sweetgum and sumac are very susceptible to hexazinone. Longleaf pine is tolerant of hexazinone at prescribed rates. Blueberry, legumes, grasses, and many other forbs are largely unaffected or will recover from application. Hexazinone is soil active and so is mostly absorbed by plant roots with minor foliar uptake. It works best when applied to moist soil. Hexazinone's persistence in forest soils is relatively brief with a typical half-life of 90 days. It is highly soluble in water and leaches readily.

Hardwood trees are significant competitors for resources required to optimize growth in pine plantations. Numerous studies have documented growth and volume increases from early vegetative control treatments in pine plantation^{5,6}. The growth benefit derived from vegetative control is long lasting with differences in height and diameter con-

tinuing to diverge into mid-rotation⁴.

The removal of hardwood trees and brush also increases the number of legumes, native grasses, other forbs in the understory⁸. Longleaf pine ecosystems require some type of woody competition control to restore or maintain a favorable understory plant community⁹. Without control, especially frequent fire (1-3 years), the dense canopy of hardwood will shade out desirable grasses and forbs. Low rates of hexazinone is very effective at controlling oaks on the sandy sites while selectively sparing the wiregrass, bluestems, and other native grasses associated with longleaf pine ecosystems³.

The purpose of our project was to demonstrate the benefits realized from the use hexazinone to control turkey oak in a longleaf pine plantation. We hypothesized that hexazinone would provide effective oak control and the young longleaf trees would respond with increased growth. We also assumed a decrease in shading would encourage colonization of understory plants and stimulate the expansion of those already present, especially wiregrass.

Methods

The study was initiated in 2006 at Bladen Lakes State Forest located in southeastern North Carolina. The predominant soil is a Wakulla series – a very deep, somewhat excessively drained, rapidly permeable sandy soil of the Coastal Plain that is low in organic matter, nutrients and water holding capacity. Precipitation is abundant in the region averaging 49 inches per year. The soil has a site index of 70₅₀ for longleaf.

Prior to a clearcut harvest in fall of 1999 the site was occupied by slash pine stand. In January of 2002 container grown longleaf seedlings were hand planted (10 x 10 spacing - 435 seedlings per acre). No site preparation treatment

was used before planting. Numerous oaks present on the site vigorously sprouted and gained dominance. Lesser amounts of loblolly pine, persimmon, sweetgum, and cherry were present. A poor community of wire grass, and bluestem and other graminoids and forbs occupied a small percentage of the understory. A dormant season burn was applied to the entire study area was in January of 2015 and February of 2017.

In May of 2006 a one-time broadcast treatment of hexazinone was applied over top a portion of the four year-old seedlings along a 200 foot strip near the eastern boundary of the tract. The remainder of the stand was untreated. Treatments were; a) 2.3 lb. hexazinone (Velpar ULW_{TM}) per acre as granular formula applied using a backpack blower, and b) control that received no hexazinone. Four one-tenth acre (0.04 hectare) measurement plots were established on the study area - two per treatment. In 2012, because of poor growth in the two untreated plots that could not be attributed to the effects of the herbicide treatment, we installed two additional untreated plots immediately adjacent to the treated plots. We believe these new plots have growth rates similar to the entire study area and will be less biased.

In October of 2006 we counted the number of woody plants and measured the longleaf height and diameter within the plots establishing a pre-treatment baseline. Measurement were done in the Fall of 2007, 2012, and 2017 to assess changes in the number of turkey oak and other woody stems and evaluate diameter and height growth of the longleaf trees. In 2017 four 39.4 inches diameter (1-meter) sub-plots were randomly established within each quadrant of the main plot to assess percent cover of grasses, forbs, litter, shrubs and saplings, and document species present. This report evaluates performance (height and diameter) using the untreated plots established in 2012 compared to the original treated plots established in 2006 and evaluates the response of the understory plant community.

Results

The longleaf pine saplings and grass stage seedlings were unaffected by hexazinone application. No seedlings or saplings in the study plots died and no phytotoxicity was observed after the herbicide application. The exception to this was a few longleaf saplings that died in an overlap area where the seedlings likely received a double dose of herbicide in an overlap area between spray swaths (Figure 1.).

The application of hexazinone had positive effects on the growth performance of the longleaf pine and the abundance of turkey oak, grasses and forbs. In 2012 (six years



Figure 1. A longleaf seedling depicting damage from herbicide mis-application.

after application) the number turkey oak stems in the treated areas had decreased 93 % while those that were not treated increased 41 % (Table 1.). The number of persimmon trees increased on both the treated and untreated area by 33% and 34% respectively.

	Number of Turkey Oak		
	2006	2012	% change
Treated	131	9	-93%
Untreated	170	240	41%

Table 1. The use of hexazinone was effective in reducing the number of turkey oak .

The control of turkey oak was beneficial to tree growth in our study. The longleaf trees in the treated area showed significant gains in height and diameter following their release from competition. At age 16 the longleaf average total height was 37.7 feet and 28.6 feet in the treated and untreated plots respectively. Total average height in the treated plots are 9.1 feet greater representing a 24% gain over the untreated plots. Average diameter at breast height (DBH) is 6.0 inches and 4.4 inches for the treated and untreated plots respectively, a 2.4-inch DBH gain for the treated plots.

Sixteen years after hexazinone treatment, we observed substantial differences in the understory plant communities between the two treatments. Species diversity and richness is higher on the treated plots particularly for the grass species. The forbs persist at low levels in the treated plots and are found in only trace amounts in the un-treated plots.

Number of species found in the treated plots was greater by 70%. Wiregrass (*Aristida stricta*), bluestem grasses, and forbs are more abundant in the treated plots ranging from 10% to 75% percent cover. Very little grass or forbs were found in the non-treated plots with percent cover ranging from a trace to less than 10%. Photographic evidence of the differences is apparent in Figure 4. *Aristida stricta* (wiregrass), *Andropogon terarius* (splitbeard bluestem), *Schizachyrium scoparium* (little bluestem), *Andropogon glomeratus* (bushy bluestem), none. *Discanthelium spp.*, *Eupatorium spp.*, *Hypercium spp.*, *Linaria spp.*, *Carphephorous spp.*, *Bulbolystis spp.*, *Optunia spp.*, *Lupine spp.*, Sedges, Earthstar, and *Vaccinium spp.* were identified, with wiregrass and bluestem grasses being the most abundant. The increased light reaching the forest floor and not fire alone is the likely reason for the differences seen between the two areas.



Figure 2. Photo of a sub-plot established to assess understory plant community 11 years after the area was treated with hexazinone.

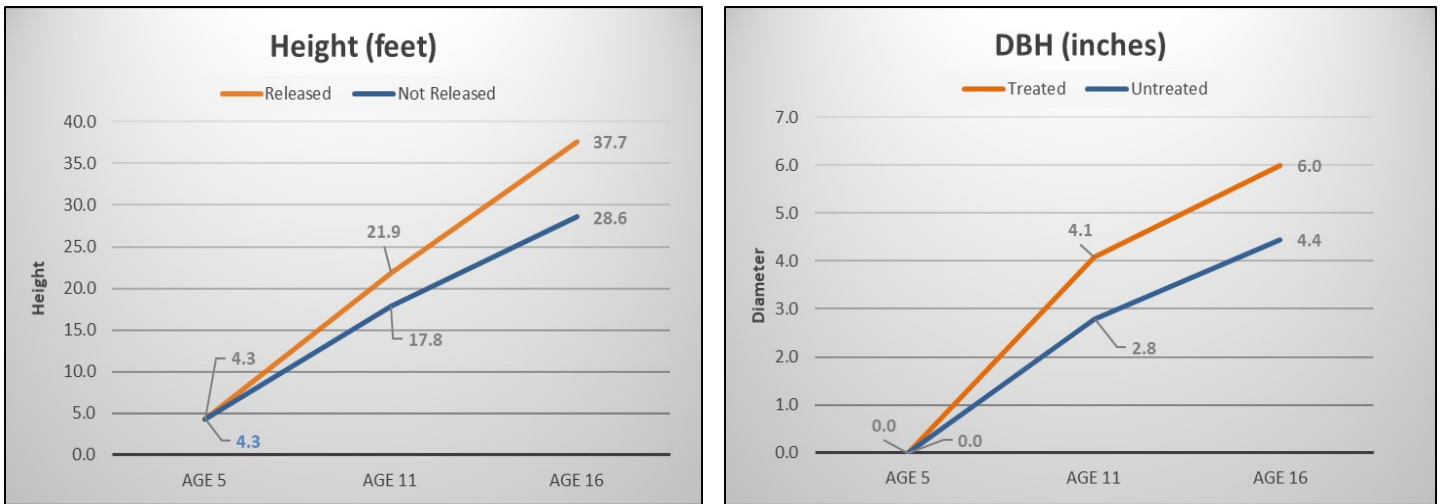


Figure 3. Height and diameter at breast height increased following the application of hexazinone to control. At age 16 the longleaf trees in the treated plots averaged 9.1 feet taller with a diameter at breast height that was 2.4 inches greater.

Conclusions

Hexazinone treatment on this xeric sandhills site greatly reduced the number of turkey oak that were predominant with the planted longleaf. The significant reduction in oak competition gave the longleaf trees access to site resources that resulted in positive diameter and height growth. The 24 % gain in height and diameter provides a significant volume increase compared to no treatment that will increase timber products value at harvest and shorten the stands rotation length.

The decline in turkey oak cover created an opportunity for wire grass, bluestems and forbs already present to expand. Eleven years after treatment the abundance of grasses and forbs in the hexazinone area was significantly greater covering at least 25 % of the forest floor. Other studies have reported that while broadcast application of hexazinone initially depress the abundance of forbs, they quickly recover within a year or two. In our study the understory has rebounded well from the toxic effects, if any, of the hexazi-



Figure 4. One area of this longleaf sandhill site was treated with hexazinone while the adjacent area was left untreated to demonstrate the effects of turkey control on the growth of the longleaf pine trees and the expansion of the wiregrass, bluestem and other forbs in the understory. A) Untreated area and B) Treated area. Photos taken in August 2012, six growing seasons after application. C) Untreated area. D) Treated area. Photos taken October 2017, 11 growing seasons after application

none. The abundance of wiregrass and other grass cover provides a fuel to facilitate a prescribed burning. Wiregrass needs fire to promote quality flowering and seed production, and further stimulate its spread throughout the site. Wiregrass shows the greatest reproductive response when burned in the early summer (May-June)¹. Conducting prescribed burns during the growing season should be considered to further expand the wiregrass component.

The dormant season prescribed burns conducted on this site did little to reduce the number of turkey oak stems. Fire top-killed the smaller turkey oak, but they quickly sprouted. After the burn the top-killed turkey oak stems are smaller, but multiple sprout increased abundance. Other studies show similar control results.

In our demonstration project we recorded a positive response in the understory plant community through the elimination of turkey oak shadowing the forest floor. Because of the hexazinone effectiveness and the broadcast application method very little residual oak persists in the treated areas. While that is good for timber production, it may not be appropriate for biodiversity and overlooks the importance of retaining oaks. Heirs examined the ecological role of pyrophytic oaks, such as turkey oak, blackjack oak, in a longleaf ecosystem to show they are critical component of the sandhills. He suggests that land managers should avoid strategies that eliminate pyrophytic oaks and keep a small component of oak in the longleaf forest². A broadcast application like the one done in this study causes widespread mortality to the understory plants and eliminates most of the oaks. Using a more directed application, like a spot treatment, delivers a more selective treatment for retaining oaks, grasses and forbs, and thereby maintain species richness and diversity.

Citations

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