Burning for Oak Regeneration:

What's Inside:

IOWA STATE UNIVERSITY
University Extension

PM-2088G January 2014

Historical and Current Conditions

Prior to European settlement, an estimated 12 million acres of the Midwest was covered by scattered oaks (savannas). Presettlement oak savannas were maintained through periodic disturbances (browsing and burning) which increased diversity and vigor of the understory herbaceous vegetation while maintaining openings in the canopy through the removal of thin barked trees. These openings allowed sunlight to reach the forest floor where acorns from the surrounding mature oak trees could germinate and grow.

Following European settlement, populations of native grazers declined and fire suppression became widespread across the Midwest. Relaxation of this disturbance regime allowed oaks to advance into the open areas creating the dense oak forests we see today (which are roughly 150 years old). Oak acres in Iowa reached a maximum in the mid-1800's at just over 5.7 million acres and have been declining ever since. Today, roughly 1.15 million acres of oak dominated forestland remains in Iowa. These forests continue to decline at a rate of over 4,500 acres per year.

Fire's Role in Oak Ecosystems

Widely spaced mature oaks in the overstory allowing sunlight to promote a diverse herbaceous understory with limited mid story structure. Photo courtesy of Gregg Pattison.

The long relationship between oaks and fire has resulted in several adaptations to fire: thick bark which provides some protection from heat, leaf litter which dries quickly and promotes fire spread, and an ability to quickly resprout from the root collar. These adaptations allow for rapid growth of aboveground stems from existing root systems which "capture" growing space and vie for light resources more effectively. Fire removes litter and enhances nutrient rich mineral seed beds, allowing acorns to germinate and grow with less competitive stress.

Over time, the lack of periodic fire and other disturbance has resulted in Iowa's over-mature oak stands being replaced through natural succession by shade-tolerant species. Thinner barked shade-tolerant species such as maple, elm, and hackberry outcompete oaks for space, light, and nutrient resources. These species eventually produce the majority of the leaf litter, which dries slower and burns less readily and makes restorative fire difficult. Shade tolerant species alter the understory light regime by casting dense shade on the forest floor. this shade eliminates the herbaceous layer and further reduces available fuels needed for woodland burning.

Prepared by: Jesse Randall, ISU Extension forester, and Ryan Harr, Assistant Scientist II, Natural Resources Ecology and Management. Related publications can be found on the ISU Extension Forestry web page at www.forestry.iastate.edu or at the ISU Extension Store at www.extension.iastate.edu/store. Search for publications PMR 2088A, Developing a Prescribed Fire Burn Plan, PMR 2088B, Tools and Safety Gear, PMR 2088C, Why, When, and When Not to Burn, PMR 2088D, Smoke Management for Prescribed Burning, and PMR 2088E, Ignition Techniques. Materials listed are suggested safety items; many good substitutes are available. Original material adapted from Randall and Haley Frater. No product endorsement is implied by inclusion in this publication.

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Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Cathann Kress, Director, Cooperative Extension Service, Iowa State

What To Consider When Burning:

WHAT AGE TO BURN

Fire is one of several tools used to regenerate a forest. In the Midwest, an increasing numbers of forestry practitioners are utilizing prescribed fire specifically for oak regeneration, when the stand is nearing maturity and is 10-15 years from a planned harvest. A series of fires may be needed to clear the understory of unwanted shade tolerant shrubs and tree seedlings and saplings, as well to prepare the seedbed for acorn germination by exposing mineral soil. A follow-up fire 2-4 years after a large acorn mast crop can help to stimulate the young regenerating oaks and suppress the shade tolerant species. Using fire for the purpose of providing advanced regeneration in the middle stages (stand age of 50-75 years) of the overall stand rotation (100-150 years for oak) is not advised. Oak seedlings will not live in the shade cast by the overstory trees.

Photo shows severe fire scar along a single growth ring when the tree was young and radiating damage that has impacted wood quality

Foresters are seeing some reluctance by timber buyers to purchase standing timber that shows signs of repeated fires. As such, fire SHOULD NOT be conducted when the tree's diameter is below 6" for white oaks and 8" for red oaks as the likelihood of stem damage greatly decreases as the stems increase in size and the bark thickens. Similarly, burning when the stand is overly mature (crown dieback and disease is prevalent) can lead to decreased resprouting ability, lower quantities and qualities of acorns, and increased stem damage as fire may burn weak or decayed areas first. Over-mature, slow growing trees are also slower to compartmentalize fire damaged areas, possibly resulting in further disease and decay problems.

WHEN TO BURN

Dormant season fires (early spring or late fall) have been shown to be effective. Spring burns appear to eliminate competitors better than a fall burn, when timed to coincide with early leafout period to target shade intolerant species. Burning during early leaf-out stresses reserves of unwanted, non-fire adapted shade intolerant species and thus, reduces their resprouting and survival ability. Spring burns can be more difficult to implement, with the shorter time window following snow melt and spring ephemeral green-up. Resulting higher humidities and fuel moistures tend to produce more smoke and a less uniform burns through the understory. Higher windspeeds may also be needed to move the fire through the timber and disperse smoke from the forest stand.

A fall burn may give a more uniform completeness in the understory, but may also allow more competitors to survive as many species will have gone dormant for the winter. Fall burns may need to occur more regularly to control or reduce competition from shade-tolerant species. Care should also be taken when managing prescribed fires near woodland edges in proximity to dry, unharvested row-crop fields, which are highly susceptible to fire in the fall.

Mechanical removal of midstory structure during shelterwood harvesting facilitates understory growth of herbaceous layer plants which add fuel for future prescribed fires.
Photo courtesy of Jesse Randall

Shelterwood Burn Technique

Using a shelter-wood burn technique combines the use of manual/mechanical tree removal (to increase understory light and soil temperature levels) and prescribed burning to promote oak regeneration in the understory. Tree removal is done through a shelter-wood cut, where a portion of the mature overstory trees and all unwanted midstory species are removed to increase sunlight and expose mineral soil improving seedbed conditions, and remove unwanted species from seeding into the site. Harvests are generally done once or twice prior to a burn (about 5 to 20 years apart) depending on the amount of advanced regeneration that establishes. The first harvest is used to stimulate natural oak regeneration and remove the unwanted non-oak component in the overstory as well as any poorly formed or diseased / damaged oaks. Depending on the advanced regeneration density, a follow-up harvest may be needed to increase oak regeneration numbers and/or growth of the desired understory seedlings and remove any remaining unwanted species from the stand. Trees selected for removal should be selected based on a rank order (non-oak, damaged or diseased oaks, poor form oaks, and then co-dominant healthy oaks). Following harvest, 40-50% of the canopy should have been eliminated leaving only healthy, well formed oaks as seed trees. Several years after the final harvest (3-5 years) a prescribed fire can eliminate competing tree species that may have germinated or grown larger since harvest, and return nutrients back to the soil from the litter and slash from the initial stand thinning operations. Care should be taken when conducting this burn as large amounts of slash fuels create "lethal" fire conditions. It is CRITICAL to remove slash piles from the base of existing mature trees, as these piles can severely damage or kill mature trees with the intense, sustained heat that slash piles produce. Oak seedlings that are exposed to fire may be top-killed, but respond by resprouting from the root collar and will grow vigorously given their established root systems. After advanced regeneration is established, with enough stems per acre to ensure oak dominance in the next stand (5000 germinants/acres for seedlings and 500/acre for seedlings 4-5' tall), the remaining overstory trees need to be removed to provide full sunlight conditions.

Timber buyers often believe that fire in woodlands reduces wood quality, and thus will decrease their eventual profits from the harvest. As such, they often place a lower value on bids when they purchase timber knowing that it has been recently burned or will be burned prior to the harvest. If the commercial value of the timber is a primary concern, there are preemptive steps that can be taken to reduce the impacts of prescribed fire:

• Remove all large fuels near the commercially valuable trees. Fuels in close proximity to the stem of a tree greatly increases the intensity and duration of exposure, compared to a passing leaf litter fire.

• Remove dead and hollow trees that may smolder for days (logs that smolder internally may go undetected, and can restart the fire after the burn crew leaves). Standing dead trees may act as fire chimneys (hollow trees that can send sparks up and over a fire control line) should also be cut down and removed.

• Thin or clear fuels on the downslope side of commercially valuable trees.

• Take steps to protect valuable trees – such as clearing all fuels from the base and ladder fuels that may allow fire to reach lower branches -- that are more susceptible to fire damage such as the thinner barked less fire resistant red oak.

Be sure to clear brush piles from the base of valuable timber trees. Brush piles increase the heat and residence time and can kill the cambial zone under the bark. This dead zone may take years to appear and will greatly impact the health and longevity, essentially killing that side of the tree. Photo courtesy of Jesse Randall.