AEN-173

Shelterbelts for Livestock

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Livestock must maintain a normal body temperature to optimize their production potential. Providing shade and protection from wind are two ways producers can aid in managing the impact of temperature-related stress on their livestock. An all-season tool for addressing this issue is a shelterbelt, which is a strategic arrangement of trees or other dense vegetation that is designed to provide shade and protection from winds. Shelterbelts are used predominantly in the Midwest, high plains, and flatter areas of the country. Shelterbelts are needed where animals are confined to fields with only grass and a fence. Parts of Kentucky have rolling hills, which allow livestock to seek shelter from high winds by getting in draws and behind hills. However, on hot days with high humidity, livestock can be seen crowded under a single tree or cooling themselves in a pond. Practices that would benefit livestock in Kentucky include the establishment of shadebelts that provide cool summer breezes and relief from a scorching sun and shelterbelts to protect animals from high winds when their hair coats are wet. There are five types of woodland shelter management practices that are used for protecting livestock, including shadebelts, woodlot blocks, forest grazing, silvograzing, and shelterbelts. If the trees are harvested for timber, then all of them would fall under the heading of agroforestry. However, for the purposes of this publication, they will be referred to as shelterbelts.

A shelterbelt can provide many of the following benefits to livestock:

- Increased feed efficiency and weight gains. Cold weather increases the amount of energy needed to maintain body temperature, whereas hot weather decreases grazing time and grazing efficiency.
- Improved survivability. Cold winter temperatures combined with strong winter winds are harmful to livestock and newborns with wet hair coats.
- Increased milk production. Pastures without shade can lower milk production by 20 to 30 percent.
- Increased reproductive fertility. Livestock with access to shade may have a 30 percent increase in conception and pregnancy rates over livestock without shade.
- Improved forage use. Livestock will congregate closer to water sources, which results in overgrazing near the water source and undergrazing farther away from it. Incorporating shade throughout pastures can increase pasture utilization.
- Improved water quality. The planned placement of a shelterbelt can improve water quality by keeping livestock from loafing in riparian areas, streams, and ponds.
- Reduced wind velocity. It is estimated that a tree planting may reduce wind by 70 percent.
- Soil and air temperature changes. Shelterbelts may reduce the effects of cold in winter by 50 percent and can reduce total heat load by 30 to 50 percent.
- Changes in relative humidity levels within the sheltered area. This is accomplished by shade and the microcooling effect created by evapotranspiration from the leaves of the trees.

A shelterbelt can also provide the following benefits to the farming operation:

- Supplying the farm with timber and fencing material at low cost.
- Generating revenue from carbon credits.
- Providing revenue from felled timber and harvested nuts.

However, possible limitations to the practice may include the following:

- Reduction of stock-carrying capacity, resulting from loss of land area.
- Reduced forage yield, resulting from water consumption by the shelterbelt.
- Compaction of soil, pugging, and weed infestation adjacent to the shelterbelt.
- Transfer of more soil fertility to the shelterbelt area and away from the field.

Figure 1. Cattle use a pond to cool down, and as they leave the pond, they travel to a single tree. Since there's not enough room, they may push one another out of the shade. The management of trees, livestock, forages, and water sources should be an integrated system.

- Need for more intensive management and skill in balancing complex interrelationship between livestock, forages, soils, and trees.
- Reduction of land area used for conventional production.
- Hinderance in the use of large equipment.
- Altered vehicle traffic and grazing patterns, resulting from new obstacles in a field.
- The cost of fencing.

Some limitations can be offset by managed grazing. For instance, lower air and soil temperatures in summer generally increase forage yields under trees if cattle are rotated properly. Also, if grazing is managed, soil permeability is increased, leading to greater water-holding capacity.

A shelterbelt is not a practice that most producers consider because of the potential limitations. However, in most cases, the benefits of a shelterbelt will more than offset any potential limitations. Livestock producers interested in increasing livestock performance and improving animal welfare should consider implementing a shelterbelt to protect livestock from wind, cold, and scorching sun.

Design Considerations

Site Evaluation

Site evaluation is probably the most important step in planning a shelterbelt. Some of the best examples of where not to site a shelterbelt can be gleaned from the locations of existing trees in pastures. Existing trees may be located in riparian areas. A riparian area is the land area immediately adjacent to any body of water (e.g., a stream or pond). Loafing under trees in a riparian area may cause trees to become diseased or die. However, the greater concern is that the location may negatively impact water quality as a result of manure packs, which can build up and run off into streams and waterways.

The size of a shelterbelt should be scaled to meet the needs of 80 percent of the herd. Figure 1 shows an image of a pasture with one tree growing in a draw. In this example, there are not enough trees for these animals to escape the heat. One small tree will provide limited relief for a small percentage of the herd, possibly leading to aggressive behavior within the herd because of the scarcity of shade. The location of a tree in a draw will also allow any manure deposited under the tree to run off into local waterways. As a rule, there should be at least one linear foot of shelterbelt length for each animal.

Placing structures in bottomland is a mistake because that is where drainage will concentrate, creating more mud, and it may lead to diseases and health issues. Figure 2 is not a shelterbelt, but it is a perfect example of how the improper placement of a shade structure can create a covered pond.

Fence lines may contain trees growing along them. However, the fence line may be oriented in the wrong direction, and therefore they may not provide protection. In addition, there should be enough shelter for 80 percent of the herd, and the shelterbelt should provide 80 percent blockage of harsh winds. In Kentucky, harsh wind patterns will typically originate from the northwest and northeast. An effective shelterbelt should be a minimum of three rows deep. A shadebelt, however, could consist of a single row of trees, if it provides enough canopy to cover the herd.

Figure 2. A shade structure placed in a low-lying area. The compaction of the soil and subsequent ponding of water creates a mud hole of flies and disease.

Shelterbelt placement will affect animal grazing patterns and forage use. Livestock will not move far from a shelterbelt during harsh weather. A centrally located shelterbelt will facilitate short walks to forages and water.

Plant Materials

A shelterbelt can be a combination of trees, shrubs, and grasses, whereas a shadebelt would not have shrubs, allowing breezes to penetrate the understory. Regardless, it will take a considerable amount of time to create an effective shelterbelt; therefore, choosing the right species to meet the purpose of the shelterbelt from the outset is important. The most common cause of shelterbelt failure is choosing the wrong species for a site. Selected trees should be suited for the region and, more specifically, the soils. Typically, the best trees will be natives. Guidance on the most suitable trees can be determined by cross-referencing the site, using a printed county soil survey or the USDA Natural Resources Conservation Service's Web Soil Survey. The Kentucky Department of Fish and Wildlife Resources and the Kentucky Division of Forestry can also be good sources of information.

Tree seedlings can be purchased in bulk from the Kentucky Division of Forestry. A cost-effective way to obtain trees is to harvest seedlings from a woodlot and transplant them. Producers wanting high-quality nut or timber trees should consider getting stock from a breeder.

Planting Pattern and Design

A shelterbelt can be arranged in uniform block plantings, clusters, or multiple rows. Evenly distributed trees in block plantings optimize the growing space and light for both trees and forages. Trees grouped in rows or clusters concentrate shade and root effects and provide open spaces for pasture production. The spacing between trees or rows should be wide enough to accommodate equipment used for maintenance. Trees are typically planted every five to eight feet within a row, with eight to 15 feet between rows.

Planning a shelterbelt that provides free access for livestock to move to the west, north, and east sides, with adequate coverage, would allow them to take full advantage of the moving shade and avoid high winds. A north-to-south orientation allows sunlight to keep the soil dry and creates less mud, while allowing livestock to gain shelter on either the west or east side. If grazing is controlled, livestock may also take advantage of being within the shelterbelt.

Siting a shelterbelt with access to multiple sides in an already established grazing system may be difficult. This is one option, but any shelter or shade is better than none.

Siting a shelterbelt on a summit or upland position will provide downwind protection for livestock. Sizing and length of a shelterbelt should be determined based on the downwind protection area, herd size, and purpose of the shelterbelt. Again, as a rule, there should be one linear foot of shelter for each animal.

Figure 3 shows a block-planting design example for a Kentucky pasture. In this example, the spacing both between rows and within rows is eight feet. The planting has black locust trees interplanted with hardwood species, such as oak, hackberry, or walnut. Walnut and locust trees are beneficial for grazing operations because they leaf out late and drop leaves early, allowing full sun for spring grass growth and stockpiling. Black locust trees are not desirable among tree enthusiasts. However, they are a legume, which means they fix nitrogen that is added to the soil. They will grow fast, which means shade will be created sooner, and they will stimulate non-legume trees such as oaks to also grow faster. After about 10 years, the black locust trees can be thinned out to promote preferred trees.

Creating a shelterbelt does not mean the area is lost to production. One possible use for black locust trees that are thinned out would be as wood for fence posts. Producers may also gain additional income by harvesting nuts and eventually the wood, as in the case of a walnut stand. However, the true value of a shelterbelt is the contribution that it will make to livestock productivity.

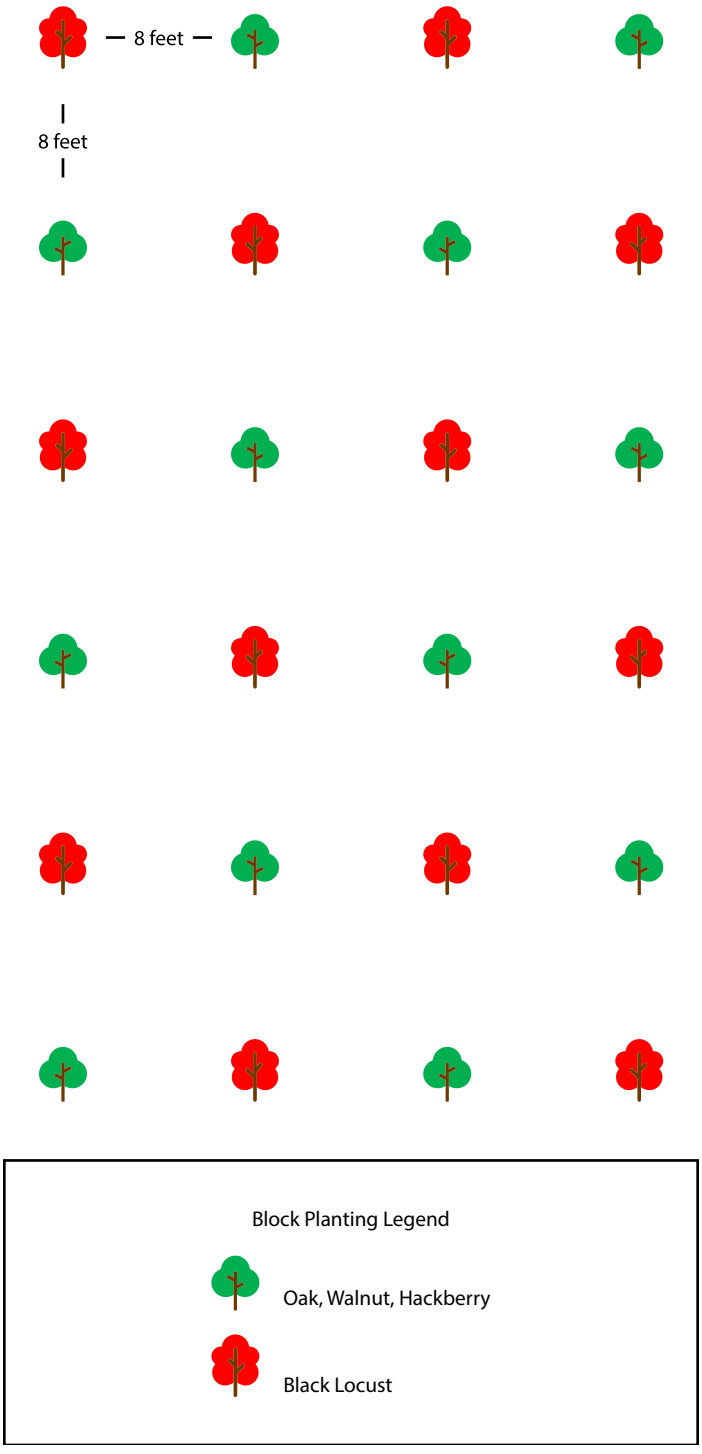

Figure 3. A block-planting shelterbelt design for a Kentucky pasture.

Establishment of Plant Material

Trees can be established in grass. Scalping or mowing the forages prior to planting may help with water availability and tree establishment. Spraying a broad-spectrum herbicide to kill established vegetation and planting a winter cover crop in which the trees will be planted can also be useful practices when creating stands.

Once the trees are planted, a producer has the option of mulching the plantings and the disturbed areas. Tree shelters (Figure 4) are also an option, as they can be used to mark the location of tree seedlings, protect them from herbivores, and stimulate growth. The extent of the prep will depend on the conditions of the site. Ultimately, how the site is prepared is entirely up to the individual.

The main challenge in creating a shelterbelt is the establishment of trees. Problems may arise due to availability of water, soil conditions, or similar factors. The main culprit related to poor tree establishment, however, is livestock. Livestock can cause branch or trunk breakage, as well as damage from leaf and seedling browsing and bark stripping. Damage to trees can lower their economic value, reduce their effectiveness, and lead to tree disease and death.

Fencing to exclude trees is not necessary in a traditional silvograzing operation if pastures are not overgrazed and the animals are rotated to fresh pastures often. Figure 5 shows a pasture where cattle have access to shade and plenty of forage. However, overstocking and overgrazing are common practices. Therefore, fencing will probably be necessary to establish a shelterbelt and to sustain it. Gates should be included with fencing to facilitate mowing and maintenance. Fencing options include temporary or electric fences, with one strand for cows or three for cow/calf situations. Opening gates and dropping temporary fencing can allow flash grazing.

Operation and Maintenance

Weed and Grass Control

Sod and mulch will do a good job suppressing grasses and weeds.

Irrigation

Precipitation is the easiest form of irrigation. However, amounts and timing of precipitation can vary. There are multiple solutions for providing irrigation, including tree-watering bags (commonly known as gator bags) or 55-gallon barrels with weep holes. A slow trickle over an extended period is much better than providing heavier irrigation that may become runoff.

Replanting

Obtaining 100 percent survival from a planting is extremely rare. A shelterbelt should be evaluated once every three years until an 80 percent stand is achieved. Replanting should occur in the fall of each year to meet performance goals.

Pruning and Thinning

Pruning and thinning are common practices to remove lower limbs and maintain the trees as they change their form. Thinning is a common practice to remove competition and undesirable tree species.

Protection from Livestock

Fencing has been mentioned as a practice to protect a shelterbelt from livestock. However, in addition to fencing, other protections may be needed. A heavy traffic pad or heavy use area (HUA), constructed using geotextile fabric and rock, may be required to control mud and erosion of trampled areas. These areas will occur

Figure 4. A tree shelter is used to protect the tree seedling and provide a greenhouse-like environment.

Figure 5. A cluster of established trees being used as a shadebelt. With rotational grazing and proper management, shadebelts do not require fencing, especially for mature trees.

where livestock congregate and loaf the most. Soil damage and compaction depend on the types of soil and their clay content, as well as the time of the year, stocking density, the amount of time cattle have access to an area, etc. However, an HUA may reduce the air exchange between the roots within the soil and the atmosphere. Air exchange is needed to maintain the flow of oxygen and gases to and from the tree roots; otherwise the stand may become less productive. Although an HUA or layer of mulch may protect the tree roots from animal traffic, it may also reduce airflow. Nonetheless, an HUA would be better than bare soil that is pummeled repeatedly. It is possible that young trees may adapt, or the root growth may stay within a fenced shelterbelt area. Therefore, an installed fence should be offset from the tree trunks to reduce root damage while still creating a shelter for livestock. For more information about how to implement an HUA, refer to Appropriate All-Weather Surfaces for Livestock (AEN-115).

Management Concepts

Figure 6 shows a group of rotational grazing pastures that do not have shade for livestock. However, the image shows a cluster of trees in the center of the pastures on a summit position. A management practice of this particular farm is to open the gate to a currently grazed pasture in summer and allow livestock to utilize the cluster of trees. As a management practice, this allows multiple rotational grazing pastures to utilize the one centrally located shelterbelt. This practice also provides a lane that the animals use to access the shelterbelt area. An area like this that is constantly used will need to be managed more intensively to ensure that the animals do not destroy the area and kill the trees.

Figures 7 and 8 show conceptual illustrations of a shelterbelt with a reinforced alley. This practice can be implemented by creating two parallel block plantings. The construction of two closely spaced groups of trees in the shape of a small lane (28 feet of space between tree groups) would allow livestock to enjoy full-day shade inside the spacious lane. Inside this lane would be an HUA. Depending on the traffic, wood mulch could be packed to both protect the tree roots and provide cushioning for when the livestock rest. Wood mulch within the lane would have the added benefit of erosion control, preventing eroded soil from leaving the site.

Every pasture on a farm may not have a shelterbelt or the topography to provide shelter. However, livestock producers should have the ability to change the order of fields used for pasture rotations to house livestock in pastures with shelterbelts when shelter is needed most.

Individual trees can serve as shade if they provide sufficient canopy. However, livestock can be hard on individual trees. Figure 9A shows a tree that has been debarked by horses. Conversely, Figure 9B shows a tree with a section of chain-link fence loosely wrapped around the trunk to protect the bark.

Figure 6. A central shade area, lined in red, is used to provide relief to livestock, with the additional benefit of being accessible to multiple pastures. A gravel lane allows the animals to reach the shade area from the pastures.

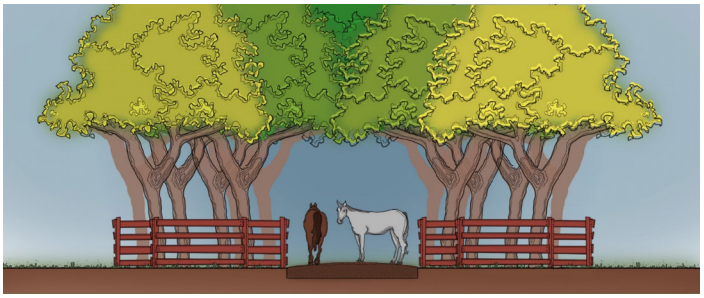

Figure 7. Two parallel blocks of trees used to create a shade alley. (Image by Corey Wilson, University of Kentucky)

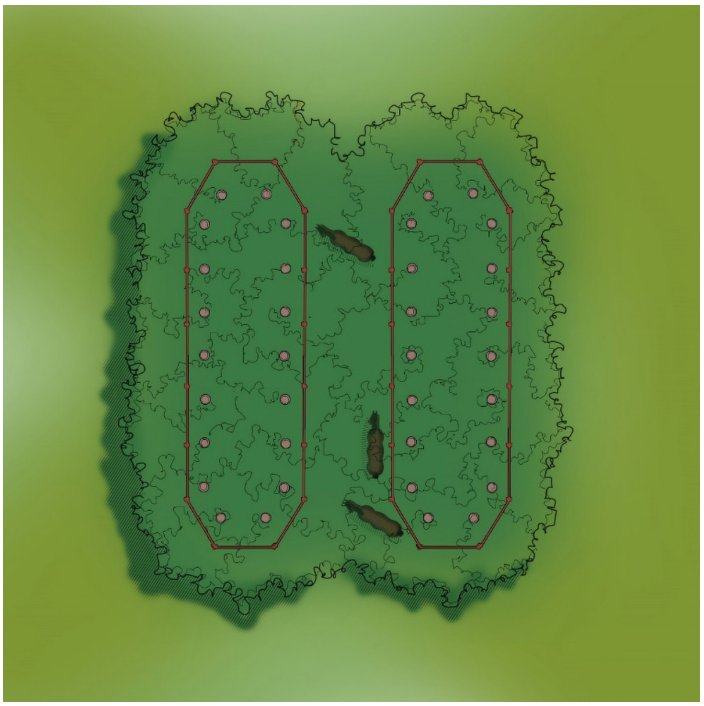

Figure 8. An overhead view of two parallel tree blocks. (Image by Corey Wilson, University of Kentucky)

Figure 9. An unprotected tree (A) debarked by horses. Wrapping individual trees with chain-link fence (B) is one method to control bark removal.

Summary

Shelterbelts are effective at blocking incoming solar radiation and harsh winds while providing seasonal cooling of surrounding air through evapotranspiration. Well-thought-out tree plantings can serve as refuge from the heat during the warm months and as added protection from extreme winds, especially during the winter. Shelterbelts can increase production of livestock significantly. A shelterbelt can also add revenue to the operation in the form of felled timber, harvested nuts, and carbon credits. A shelterbelt may also contribute cheap timber and fencing material at low cost to the farming operation. In most cases, the benefits of a shelterbelt will more than offset any limitations created by a loss in productive area. The best time to install a shelterbelt would be 20 years ago. The next best time is today.

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