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CU IN THE WOODS

Clemson Extension Forestry and Wildlife Newsletter

Pine Stand Thinning

By Patrick Hiesl and Janet Steele

https://blogs.clemson.edu/fnr/2022/10/12/pine-stand-thinning/

Forest management practices are recommended for various reasons to meet landowner management objectives, including generating income, improving habitat for wildlife species, and, most importantly, maintaining a healthy, productive forest. Properly timed thinnings in natural and planted pine stands will provide all these benefits. Thinnings are "intermediate cuttings that are aimed primarily at controlling the growth of stands by adjusting stand density." The objective of thinning is to favor the healthiest and best-formed dominant trees in the stand, removing suppressed, forked, crooked, and diseased stems. This allows the residual stems to take advantage of the additional available site resources (water, light, and soil nutrients), increasing their growth rate and, thus, their value when harvested. Properly timed thinnings throughout the life of a pine stand can more than double the diameter of trees at the final harvest compared to an unthinned stand. This article will discuss why pine tree physiology determines the spacing and number of seedlings needed for successful pine stand establishment, how a thinning schedule is selected, different thinning methods, and the benefits of thinning to the residual stand.

Pine Tree Growth Characteristics

Trees, like humans, can grow in two directions at the same time. They elongate at their shoots and roots to increase their height (primary growth) while at the same time growing in girth to increase the diameter of stems and branches (secondary growth). The cells responsible for the development of shoots and roots are apical meristems. Growth habitat varies between species and will determine the tree's shape, which can then dictate the value of that species for wood products. The southern pine species have a shoot growth pattern classified as monopodial growth, where a terminal bud elongates to initiate height growth. Pines can flush multiple times in a single growing season, with the terminal bud growing more than the lateral buds. The number of flushes is related to site quality, weather, and genetics. Pine trees also exhibit strong (excurrent) apical dominance, with the elongation of lateral buds below the terminal (apical) bud suppressed by plant hormones called auxins (figure 1). These factors create a relatively straight main stem or trunk, with a crown composed of outward-growing branches in mature trees.

Seedling spacing at the time of establishment, whether through artificial or natural regeneration, is essential in utilizing the southern pine species' growth habits to maximize the future stand's growth potential while meeting landowner objectives. While natural regeneration is a viable option for reforestation, it requires planning for adequate seed fall and implementation of site preparation to control competing vegetation before harvest for natural regeneration to be successful. Bumper

Figure 1. Three-year-old planted loblolly pine exhibiting apical dominance. Photo credit: Janet Steele, Clemson Extension.

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UPCOMING EVENTS

Timber Tax Course
Our Timber Tax Course covers emerging topics that affect woodland owners and loggers who need a basic understanding of federal income tax rules on the management of woodland property.
To register-https://www.eventbrite.com/e/2022-clemson-university-timber-tax-course-tickets-342940563457
Contact Kevin Burkett for more information-kburke5@clemson.edu

Chainsaw Safety and Handling Workshop
October 28th- Clemson
Workshops run from 9am - 3pm
Contact Janet Steele for more information-jmwatt@clemson.edu

Tree Felling Workshop
November 18th- Columbia (for Women Owning Woodlands)
Workshops run from 9am - 3pm
Contact Janet Steele for more information-jmwatt@clemson.edu

South Carolina Women in Agriculture Conference
November 4–5, 2022 in Clemson, South Carolina
See page 12 for additional details.
For more information visit- https://www.clemson.edu/extension/scwgn/conference.html
For questions, please contact Charley Maxwell-chmaxwe@clemson.edu

Forestry Association Meetings
Check out Page 6 to find your local forestry association. You do not need to own land in that county to join. Many of these associations meet quarterly and cover a lot of great topics for forest landowners.

CFE Opportunities:
You can find a list of current CFE opportunities at this website:
https://www.clemson.edu/extension/forestry/continuing_education/index.html

More Events:
You can find a list of more events at this website:
https://www.clemson.edu/extension/forestry/events.html

Check out our blog page for past articles and other great forestry and wildlife information-
blogs.clemson.edu/fnr

Pine stand thinning cont.

crops of seed for loblolly pine (Pinus taeda) commonly occur every 3-to-5 to years, while longleaf pine (Pinus palustris) can be as infrequent as every ten years. Depending on when a stand is harvested, this can often lead to a "feast or famine" situation, with either too few natural seedlings established per acre or thousands of seedlings per acre requiring pre-commercial thinning (figure 2).

Figure 2. Natural loblolly regeneration in shelterwood harvest will require precommercial thinning to establish the desired stocking. Photo credit: Dave Moorhead, University of Georgia, Bugwood.org.

Artificial regeneration, or the planting of pine seedlings, began in the 1920s by the US Forest Service to reforest cutover timberland and abandoned farmland, expanding over the next few decades as pulp and paper manufacturing grew across the south. In the early 1950s, there were less than 2 million acres of pine plantations in the US south, but this number grew to over 7 million acres by 1962 due to the Soil Bank Conservation Reserve Program (CRP). The development of a range of forestry herbicides in the 1970s and 1980s improved the control of competition on harvested sites, reducing the use of mechanical operations, which can negatively impact seedling growth by causing uneven distribution of organic matter and topsoil across a site. Additionally, the advent of pine tree improvement programs in the 1950s improved tree growth and stem quality. It increased the resistance of trees to disease, resulting in rootstock, which was more desirable than relying on natural regeneration. These factors combined to increase the number of acres of pine plantations to over 30 million acres in the US south by the beginning of the 21st Century.

The required number of seedlings to successfully establish the next stand of pine trees will depend on landowner objectives and site quality. Planting recommendations usually range from 400 to 700 trees per acre (table 1), with the lower stocking (total trees per acre) favoring wildlife habitats. Wider spacing allows additional sunlight into the stand, increasing the variety, quality, and quantity of forages and creating a greater diversity of cover types. The more open the stand, the more lateral branches the pine seedlings will produce in response to increased sunlight until canopy closure, often growing limbs along the entire stem length. The resources sent into the growth of lateral branches reduce the resources expended for height growth. More closely spaced trees encourage increased height growth, slower radial growth, and smaller lower limbs until crown closure. Widely spaced seedlings have greater radial growth than closely spaced stems, increasing juvenile wood, which can lower their value for dimensional lumber at harvest.

Table 1. Tree planting spacing.

Spacing by Feet	Trees per Acre (TPA)
6 X 10	726
6 X 12	605
7 X 10	622
7 X 12	519
8 X 8	680
8 X 10	544
8 X 12	454
9 X 9	538
9 X 10	484
10 X 10	435

Determining a Thinning Schedule

The natural development of any forest results in the healthiest, best adapted trees expressing dominance through rapid height growth, overtopping and suppressing those that are diseased or unable to successfully compete for available site resources. Smith describes this process as a "race for the sky", noting that tree height is the main factor in determining how well a tree will survive competition from other stems within a stand. Canopy closure is the point in stand development when crowns of adjacent trees begin to touch. This further increases the competition for light between the trees and shades out lower limbs, increasing natural pruning and beginning the process where the stand will naturally thin itself. Depending on the site quality, initial planting density, and quality of seedling rootstock, a first thinning can be timed following canopy closure, which typically occurs between 10 and 15 years in loblolly pine plantations and slightly later in longleaf pine stands due to their time spent in the grass stage.

Although stand age can provide a range of years for determining thinning schedules, it should not be the only consideration. The criteria for determining when a stand should be thinned and how many trees should be removed, in addition to canopy closure, are **basal area, live crown ratio, and stand volume**. Each reflects the site quality, the stand's stocking, and the vigor of the trees in the stand. A combination of 2 or more of these factors will usually be used to determine the right timing for a thinning.

Basal Area: Trees per acre (TPA) is an adequate measure of the density of trees in young stands. However, as a stand ages and the size of individual stems begin to vary, trees per acre will no longer adequately reflect the stand density since trees of different diameters take up a different amount of growing space on a unit of land. Therefore, the basal area is used. Basal area is "the area in

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square feet taken up by an individual tree trunk at DBH (diameter at breast height or 4.5 feet above the ground)". It can be determined by measuring the tree diameter and using a formula (BA=0.005454xDBH2). For forest management purposes, basal area is expressed as a total of the growing space occupied by stems on one acre (ft2/acre). If the DBH of all trees on one acre is measured, the sum of the basal area of all trees would be the basal area expressed in ft2/acre that a forest manager would use to make management decisions. Measuring all trees in a stand can be cumbersome and costly, and more often, forest managers strategically sample the trees in a stand using a wedge prism.

Figure 3. A wedge prism is used to determine basal area. Photo credit: Janet Steele, Clemson Extension.

A wedge prism is a piece of glass cut at a specific angle that allows trees within a certain distance from the prism to be counted as "in" or "out" trees. Prisms can be cut at different angles to represent a different basal area that each "in" tree represents per acre. Common prism angles are for basal area factors of 10 ft^2/acre, 20 ft^2/acre, or 30 ft^2/acre, meaning each tree represents this much basal area per acre. Pohlman describes how a homemade measuring device can also be used to get a rough estimate. An example of how much basal area can vary based on tree diameter is that it takes almost 230 trees per acre for 8" DBH trees to equal 80 ft^2/acre of basal area, but only 57 TPA if the trees are 16" DBH. Southern pine stands, either natural or planted, that reach 100-120 ft^2/acre of basal area need to be thinned, with a target residual basal area of 60-80 ft^2/acre.

Live Crown Ratio: Smith describes live crown ratio (LCR) as the "percentage of the length of stem [occupied] with living branches." The formula that can be used to calculate the live crown ratio is LCR = (Total Height – Height to First Live Branch) \ Total Height x 100. Although this may seem simplistic for use in making a forest management decision, it reflects that even dominant trees in a stand that is too dense will eventually have their crowns become too small to support their size. When the average live crown ratio in a stand drops below 40%, the stand needs to be thinned. Allowing the live crown ratio in the stand to drop too low can result in even dominant trees not being able to recover enough to reach their full volume potential.

Stand volume: Stand volume is often used to describe the merchantable timber volume, or weight, within a stand. While it is useful to know the total stand volume, the expected harvestable volume or weight is of more concern. Many logging businesses require at least one truckload of timber per acre, and a weeks-worth of timber volume, to make a harvest profitable for them. A truckload of timber is often considered 25 tons (50,000 lbs), but it can be more. We have a wide range of logging businesses in South Carolina that can produce anywhere from 20 to over 120 truckloads per week. While logging businesses with a small production can handle small acreages with lower harvestable volumes, logging businesses with a larger production need more acres or harvestable volume per acre, or both, to be profitable. Stand volume is typically calculated using tree volume equations specific to individual species, diameters, and heights. If a stand does not have enough merchantable volume for a commercial harvest, it may be wise to wait another year or two to grow enough volume for a harvest.

Thinning Operations

Pine thinnings are typically done by conventional harvesting equipment consisting of a feller-buncher, grapple skidder, and knuckle-boom loader with a pull-through delimber. For a detailed description of this equipment, consult Hiesl and Steele's publication. In a first thinning, the feller-buncher will typically remove one entire row of the pine plantation to create a skid trail that the feller-buncher and grapple skidder can drive down. Thinnings can happen at different intensities, but a fifth row thinning, where every fifth row of pine trees is removed, is very common in South Carolina. While the entire row is removed, the feller-buncher will also selectively remove individual trees from the residual rows between the skid trails. This is to remove undesired trees of low vigor or bad form and unlikely to grow into valuable timber products. The feller-buncher will create bunches, or bundles, of cut trees in the middle of a skid trail. A specific number of trees is piled so that the grapple skidder can carry a full load of trees to the landing on each trip. The landing, or log deck, is where the harvested trees will be delimbed by a trailer-mounted loader and the pull-through delimber, and it is also where individual products will be sorted. While first thinnings often only produce pulpwood and possibly biomass chips, subsequent thinnings may also have other products such as chip-n-saw, saw logs, ply logs, poles, and more. The skid trail is already established for subsequent thinnings, and the equipment function is the same.

Figure 4. A feller-buncher harvests trees in a thinning operation. Photo Credit: Patrick Hiesl, PhD, Clemson University.

Stand Damage

Following a thinning, trees can grow into higher valued products if they were not damaged during harvesting. Damage to the residual trees in the form of removed bark and exposed wood fiber can lead to rot and insect infestations, both of which can reduce the value of the stem. Most logging business owners and logging equipment operators strive to avoid damaging trees while performing a thinning. However, given the size of the harvesting equipment, this is not always possible, and some trees will get damaged. Loggers often select trees along a skid trail as bumper trees used at turns in the trail to help pivot the load behind the skidder. The bumper

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trees can get damaged but will protect the trees behind them from any damage. Seeing a bumper tree during a thinning operation can shock the landowner. However, these trees are typically harvested at the end of the thinning. Despite any protective measures, a few trees will always have minimal damage left after a thinning. This is normal and not a cause for concern. Often up to 20% of the residual trees have some form of damage, ranging from broken branches to a bark scuff and small areas of exposed wood fiber. If more trees than that are damaged and noted during the thinning, it is time to talk to the timber buyer or logger to minimize any further damage to the stand.

Improving Forest Health through Thinning

Another critical consideration for conducting thinning operations when needed is that it will maintain a healthy forest with a reduced risk of insect attack, primarily from southern pine beetles (SPB). Pine stands that are overstocked and have surpassed the target age for a thinning have less resistance to beetle attack, particularly those located on drier soils and during periods of extended drought. A report from Georgia found that the SPB hazard rating was high on a low-quality site when basal area was 120 to 145 ft2/acre in loblolly pine stands 18-21 years of age and increased to very high in older stands with higher basal area. While thinning is not a guarantee that a pine stand will not be attacked during a major SPB outbreak, it can lessen the impacts since the stand will be growing more hardy trees with less competition for site resources. Finally, thinned stands will have great air movement, which dilutes SPB pheromones and reduces the attraction of additional insects to the trees.

Conclusion

Properly timed thinnings will allow a forest landowner to improve the growth rate and health of the residual stand while earning income from removing suppressed or diseased trees that would die naturally if left unharvested or continue to grow so slowly that they are of little value at the end of the stand rotation. The desired response in the trees that remain following a thinning will be increased radial growth and the ability of the crop trees to support an adequate live crown ratio until the subsequent thinning or a final harvest. Generally, a thinning cycle of every 6 to 8 years will improve tree quality in the stand and allow the landowner to focus on growing trees into the desired product class.

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Tractors and Implements for Forest Landowners – Part 4 Vegetative Management

By Stephen Pohlman

https://blogs.clemson.edu/fnr/2022/10/14/tractors-and-implements-for-forest-landowners-part-4-vegetative-management/

Our series' first, second, and third articles covered tractor selection, ground contact implements, and property maintenance (see links at the bottom of the article). The fourth part will cover two primary vegetative management implements that the forest landowner should consider adding to their arsenal.

The first implement for consideration is a rotary cutter, commonly referred to as a bush hog. Granted, there has been much emphasis recently on putting away the lowly bush hog and more favor given to other management practices such as fallow field disc'ing and/or prescribed fire for land managers. However, there are still times and places for a rotary cutter to help manage vegetation. Examples of such would be mowing instead of plowing due to soil erosion issues, mowing where vegetation is too high to disc over because it will just wrap around a harrow's axles if the discs can even cut past the vegetation in the first place. Mowing such material and letting it lay for days/weeks allows it to begin decomposing, and then discing afterward is a more productive venture.

Image of a rotary cutter. Photo credit: Stephen Pohlman, Clemson University.

When selecting a rotary cutter/bush hog, one must first decide which width to purchase. When choosing the width, keep the following in mind: A. you want one wide enough to cover your tire tracks at least, and B. make sure you have a large enough horsepower (HP) tractor to spin the size you hook to the tractor. When selecting the width, remember the obstacles you may have to mow around on your property: tree spacing, end of fields turning around, roadside widths, etc. Lastly, when considering size/width, decide if you plan to attach this rotary cutter via a 3-point hitch or pull type. Remember to consider your 3-point hitch's 'Category hitch size' too. If you are utilizing a quick hitch on your 3-point hitch, remember to look into what might be needed to make everything mesh together. Some quick hitches require bushings on the implement, and some do not.

Once we have selected a width, we need to look at the intended task of your rotary cutter. If you plan on mowing nothing but herbaceous-type vegetation, then a standard-duty rotary cutter will do fine. However, if you plan to mow bigger stuff, such as hardwood sprouts, small-diameter trees, etc., you may want to consider a medium-duty or heavy-duty rotary cutter. Typically, the components are more substantial for each bump up in 'duty'. For example, a gearbox may jump from a 40hp gearbox on a standard-duty to a 90hp gearbox on a medium-duty, even though the cutter is expected to be used on a 40-60hp tractor. Also, the metal used for the cutter's deck will typically be thicker at each jump up in 'duty.' Also, manufacturers will beef up a cutter's deck through additional top deck bracing/bracketry and/or added bends in the deck metal itself instead of it being just a flat piece of metal.

One feature to consider on your rotary cutter is how the PTO shaft attaches to the gearbox. Smaller and lighter-duty rotary cutters typically have what's known as a shear pin. This shear pin design is to shear should you hit something you should not have. Thus shear pins are made of a softer metal, and operators should never replace them with hardened bolts. The other option to this is what's known as a slip clutch. The slip clutch has a series of stacked discs with spring pressure applying just enough force not to let them slip under normal operation. Still, as soon as you hit something you should not have, it allows the discs to slip and then go back to grabbing after you resume normal operation. As great as a slip clutch is, the operator needs to maintain their slip clutch on an annual basis (or more frequently if environmental conditions dictate, please refer to any owners/service manuals for details). Maintaining a slip clutch is very simply accomplished with basic wrenches. However, it does take a little time to perform correctly. Not maintaining a slip clutch allows the discs to rust together to the point that they do not slip properly, thus causing a safety hazard.

Safety is always a concern when using a rotary cutter. The three primary sources of injury typically come from PTO entanglement, direct contact from moving blades, and thrown objects while in operation. To help prevent thrown objects, ensure that your rotary cutter has the proper safety chains hanging over the intake and discharge shoots as a bare minimum. Woody debris, rocks, and other large items fly out at extremely dangerous speeds when utilizing this attachment. Sadly, the internet is full of gory details of dismemberment and even death due to this. Thus I'll not labor you with the details. Just know that everybody says it will never happen to them or a loved one standing nearby until it happens. Objects can come flying out from underneath in any direction. Again, use extreme caution when operating a rotary cutter.

Herbicide sprayers ('spray rig') are another vegetation management tool that can be mounted to tractors and utilized by forest landowners. For the sake of time and space, I'm only going to refer to the most commonly used tractor 3-point hitch-mounted spray rigs, as this is what most forest landowners use. Another type of spray rig that a large landowner might use, especially dove, duck, or quail field managers, is a pull-behind sprayer mounted on a cart/wagon-type system, often referred to as a pull-type sprayer.

There are a few features that the landowner needs to identify as needs when selecting the exact configuration for their spray rig. First, tractor size and how it relates

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Tractors and implements for forest landowners – part 4 vegetative management cont.

to safely carrying the weight of herbicide mixture to determine tank size. Secondly, will the pressure pump utilize a PTO-mounted pump for optimum volume and pressure, or will it be an electric pump typically found on smaller spray rigs. Due to the larger tasks at hand, most tractor-mounted spray rigs will use the PTO-mounted pump system.

Nozzle selection will depend on the primary intended usage. Do know that good quality spray equipment is not inexpensive as it is not cheaply made. High-quality nozzles throw a predictable pattern consistently. They will also last a lifetime if an operator properly takes care of his equipment immediately after usage. For those that want a nozzle primarily for spray work known as forestry release spraying (such as eliminating sweetgums in pine plantations), nozzles known as Boomless nozzles are popular. These nozzles are designed to be a single point that sprays out in an arching manner. This then allows a spray rig to be compact, so the operator doesn't have to worry about physically hitting limbs, small trees, etc., with his equipment. A traditional boom-style sprayer with spring-actuated breakaway booms is popular for those primarily spraying fields and/or large food plots. Some of these sprayers may have foam markers added to the tip of the boom to aid in seeing where you have sprayed in your last pass. Manufacturers make short-armed booms for those who prefer to spray smaller fields/food plots versus spraying with a boomless setup. Many spray rigs will still have a single wand or spray gun rigged into the plumbing. A hand-operated spray gun/wand provides operators with the ability to spot-spray individual plants/trees as well as around objects. Usually, a shutoff valve is put into place to divert your tank mixture to either the wand or your boom/boomless setup.

Another critical component of your spray rig is your pressure valve and pressure gauge. Remember, applying herbicides is about putting 'X' amount of product spread over 'X' size area. Consistency of speed, sprayed width, and amount sprayed is imperative to achieving properly applied amounts. We will assume that you can hold a constant speed with your tractor (cruise control, gear selection at constant RPM, etc.), and we will assume you are using high-quality spray nozzles to get a constant width. Still, if the pressure valve/pressure gauge is not consistently maintaining the same pressure, it will cause you to either over-apply or under-apply. Under-applying can mean plants are not controlled in a timely manner or not at all. Over-applying can have environmental impacts depending on the product used, mortality in plants that should not show symptoms, and not to mention wasted money on the amount of product sprayed that should not have. Most good spray rigs utilize quality components like this.

In case you missed them, here are the prior articles in this series:

1. Tractors and Implements for Forest Landowners- Part 1: Tractors- https://blogs.clemson.edu/fnr/2021/10/21/tractors-for-forest-landowners/
2. Tractors and Implements for Forest Landowners – Part 2: Ground Contact Implements- https://blogs.clemson.edu/fnr/2021/12/13/tractors-and-implements-for-forest-landowners-part-2-ground-contact-implements/
3. Tractors and Implements for Forest Landowners – Part 3: Implements and Attachments for Property Maintenance- https://blogs.clemson.edu/fnr/2022/03/14/tractors-and-implements-for-forest-landowners-part-3-implements-and-attachments-for-property-maintenance/

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Contact the Association nearest to you to find out about upcoming meetings!

Understory Foliar Spray Applications in More Developed Stands

By Stephen Peairs

https://blogs.clemson.edu/fnr/2022/10/10/understory-foliar-spray-applications-in-more-developed-stands/

Problematic plants and cost-share

An expanse of mature or well-developed forestland in the southeast contains plant species deemed undesirable by landowners. Plants may be suppressing 1. forest regeneration, 2. preferred wildlife habitat, 3. aesthetics, or 4. simply hindering overall enjoyment of the area. These plants may be non-native, invasive species such as tree of heaven (*Ailanthus altissima*), Chinese wisteria (*Wisteria sinensis*), Chinese privet (Ligustrum sinense), or a number of others. Some native species poison ivy (*Toxicodendron radicans*), poison sumac (*Toxicodendron vernix*), or coralberry (*Symphoricarpos orbiculatus*) may also hinder landowner usage or the implementation of management activities.

The Natural Resources Conservation Service (NRCS) has a cost assistance program named the Environmental Quality Incentives Program (EQIP). One of the practices covered in this program is brush management (code 314). Landowners whom have gone through the enrollment process and are approved may opt to utilize this program to assist with lessening the financial burden to control such plants in the understory of developed or mature stands. The author has worked with numerous clientele in the past whom were contracted within the EQIP program. The following are results and observations from work on these jobs as well as supporting scientific literature.

Recommended tank mixture

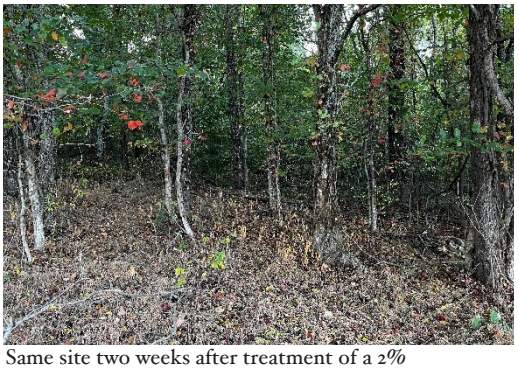
Understory foliar spraying can be an enjoyable experience for those that like to put "sweat equity" into their property. Aside from the cost of herbicides and a backpack sprayer, the financial burden is minimal, especially when the landowner is engaged in a cost-share program. My general, lower cost recommendation for treating a spectrum of plant species would be to combine a triclopyr (either ester or acid formulation) product with glyphosate. Triclopyr would be approximately 1% - 2% (1% if using acid formulation, 2% if ester) of the solution and glyphosate as 2% - 3% of the same solution. These herbicides are arguably the cheapest options and both have little to no residual soil activity. This attribute reduces the potential threat (mortality/ crown dieback) to overstory tree species via underground root uptake. Care should be taken to avoid applications when air temperature reaches above 90°F as volatilization by ester triclopyr can occur and damage overstory canopy. According to Miller (2003), triclopyr ester (acid formulation should also work) can be used to control the following:

1. Tree of heaven
2. Mimosa/silktree (*Albizzia julisbrissin*)
3. Paulownia (*Paulownia tomentosa*)
4. Chinaberry (*Melia azedarach*)
5. Tallowtree (*Triadica sebifera*)
6. Autumn/Russian olive (*Elaeagnus sp.*)
7. Winged burning bush (*Euonymus alata*)
8. Chinese privet
9. Bush honyesuckles (*Lonicera sp.*)
10. Nandina (*Nandina domestica*)
11. Multiflora rose (*Rosa multiflora*)
12. Oriental bittersweet (*Calestrus orbiculatus*)
13. Climbing yam vines (*Dioscorea sp.*)
14. Winter creeper vine (*Euonymus fortune*)
15. English ivy (*Hedera helix*)
16. Japanese honeysuckle (*Lonicera japonica*)
17. Kudzu (*Pueraria montana*)
18. Vinca/Periwinkles (*Vinca sp.*)

****the publication advises basal bark applications (20% herbicide with 80% basal oil) for larger stems for most of the plants listed above. Given the herbicide mode of action, foliar sprays that cover most of the plant foliage at lesser rates should theoretically also provide adequate control. The author has observed this outcome on a number of the species in the field post-treatment.*

Triclopyr is excellent at controlling a range of woody plants, but ineffective on controlling most grass species and has a limited spectrum of forb control (based on the Garlon 4® and Trycera® label). The addition of glyphosate gives the applicator the ability to control a greater range of herbaceous vegetation. Thus, a combination of these two products will control most of the treated vegetation within target zones.

Understory "carpet" of Nepalese browntop (pre-treatment). Photo credit: Stephen Peairs, Clemson University.



Same site two weeks after treatment of a 2% glyphosate solution. Photo credit: Stephen Peairs, Clemson University.

Glufosinate-ammonium as a substitute for glyphosate

For individuals that would prefer to use an alternative to glyphosate, glufosinate- ammonium (Finale VU®, etc) can control numerous grasses, broadleaf forbs, and multiple hardwood/pine species (according to Finale VU® label). Research on invasive plants Glufosinate has been effective

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Understory foliar spray applications in more developed stands cont.

(82%-85%) at controlling microstegium (Judge and others 2017). According to Takano and Dayan (2020), glufosinate ammonium has been used on glyphosate resistant crops but there is inconsistency in its effectiveness compared to glyphosate. The study also suggests that grasses are less susceptible to glufosinate compared to broad leaves. Ultimately, the user must identify the target species to be controlled, then ensure the glufosinate-ammonium substitute herbicide will have high efficacy by checking the label to ensure the plant is listed as a species controlled.

Tree of heaven, multiflora rose, Chinese privet, and callery pear showing chemical dieback (desiccation, chlorosis, and wilting) symptoms at two weeks post treatment (triclopyr + glyphosate mixture). Photo credit: Stephen Peairs, Clemson University.

Increased rate for waxy-leaved plants

Some of the waxy leaved species such as English ivy, Vinca major/minor, leatherleaf mahonia, holly (*Ilex sp.*), winter creeper, oriental bittersweet, etc. may not be controlled at lower triclopyr/glyphosate application rates. This may be caused as a result of the epicuticular wax inhibiting herbicide absorption into the plant's cells. The applicator may opt to slightly raise the application rate up a couple percent or use an oil adjuvant (such as a basal oil or crop oil concentrate) to increase absorption into the plant. In some cases, secondary applications may be warranted to achieve full control in problematic areas.

Some waxy leaved species, such as the Vinca (top picture) and English Ivey (lower picture), can be controlled with triclopyr herbicide though application rate may need to be increased (up to 3% triclopyr product) or conduct a secondary treatment to the infected area. Both of these sites were damaged but not fully controlled by the first spray attempt. Photo credit: Stephen Peairs, Clemson University.

Aminopyralid use on invasives

The presence of kudzu is arguably the most problematic of all the invasive species in that the vine completely "suffocates" almost the entire plants in an infested area. The author has sprayed multiple herbicides atop of kudzu in a demonstration area at the John De La Howe Governor's School of Agriculture. Foliar applications included treatments of clopyralid (Clopyralid 3®), triclopyr (Remedy®), aminopyralid (Milestone®), metsulfuron methyl (MSM60®), and picloram (Grazon®). All of these herbicides appeared to control kudzu when foliage was dampened with solution. Of all these herbicides however, aminopyralid (Milestone®) was the only one that completely deadened individual treated vines when only a portion (approximately lower 12' reached by sprayer) of the vine received spray solution. The author has applied kudzu treatments in multiple states over his career and in the case of vines climbing trees, has always had only partial deadening where solution actually contacted foliage (for every herbicide besides aminopyralid). In those instances, a cut stem treatment was needed to sever the vines then immediately apply a cut stem herbicide treatment. A one-time application of aminopyralid has the potential to reduce labor costs/time spent on control measures.

Milestone® (Aminopyralid) fully deadened the kudzu vines in these field grown white oaks. Only an approximate height of 12' (or as high as the pressure sprayer could reach) was made wet with spray solution. The amount applied was adequate however to deaden the entire vine which reached into the upper canopies. Photo credit: Stephen Peairs, Clemson University.

The Milestone® herbicide label also lists the following additional invasive or problematic plants as being controlled:

1. Tree of heaven
2. Mimosa/silktree
3. knapweeds (*Centaurea sp.*)
4. black locust (*Robinia pseudoacacia*)
5. honey locust (*Gleditsia triacanthos*)
6. sicklepod (*Cassia obtusifolia*)
7. Japanese stiltgrass/Nepalese browntop (*Microstegium vimenium*)
8. Wisteria species (*Wisteria sp.*)

**most legumes are susceptible*

Aminopyralid could be substituted in a tank mix for either triclopyr or glyphosate to improve plant control for understory spray applications pending the targeted species. The herbicide should have negligible damage to overstory trees or grass species which may be beneficial for establishing early successional habitat beneath

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Understory foliar spray applications in more developed stands cont.

disturbed (commercially thinned) stands. This herbicide is commonly used in pasture or grassland management. Research has found the addition of aminopyralid to tank mixes for forestry applications as being beneficial as well.

Treatment of larger saplings

There will likely be some stems that may be too large/tall to adequately cover enough foliage with herbicide solution to induce mortality. Basal bark applications, cut stump herbicide treatments, or stem injection (hack and squirt) should be used for these stems. Commonly used herbicides for these practices include formulations of triclopyr (Garlon® products, Trycera®, etc), imazapyr (Arsenal AC®, Polaris AC®, Alligare 4 SL®, etc), and aminopyralid (Milestone®). Lowe and others (2008) found up to 100% mortality could be obtained by applying either triclopyr (ester product) or imazpyr with basal oil as basal bark sprays on Amur honeysuckle (Lonicera maackii), autumn olive (Eleagnus umbellata), multiflora rose (Rosa multiflora), and black cherry (Prunus serotina). Similarly, DiTomaso and Kyser (2007) found both imazapyr and triclopyr were effective, applied as either cut stump, basal bark, or stem injection treatments, having <90% reduction in vigor and resprouting of tree of heaven. In the aforementioned study, the poorest rate of mortality of the herbicide treatments was 83% for basal bark application on multiflora rose. One study (found contrary results and suggests that using triclopyr ester with basal oil alone will only control the treated stem but will not completely control resprouting from roots. Timing application during the growing season did not have an impact on results. The addition of a soil active herbicide (such as imazapyr, picloram, or metsulfuron methyl) could achieve control but may be detrimental to overstory stems. Thus, a secondary application would be warranted to control resprouting.

In summary, the triclopyr plus glyphosate solution should provide control of most plant species found in the understory of developed stands. Collateral damage (such as advanced oak regeneration) of desirable plants should be expected even when applicator care is used to avoid direct spraying. These herbicides should not damage overstory trees however due to the lack of residual soil activity. Glufosinate-ammonium is a possible substitute for glyphosate but may be of lower efficacy. Aminopyralid may be the most optimal herbicide to apply on kudzu and also provides great control of leguminous species such as mimosa, locust, etc. And lastly, basal bark applications using ester or acid formulations of triclopyr will provide favorable levels of vegetation control on larger sapling sized plants.

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Your Pond as a Focal Area for Wildlife: Management of Watershed Zones

By Cory Heaton

https://blogs.clemson.edu/fnr/2022/10/10/your-pond-as-a-focal-area-for-wildlife-management-of-watershed-zones/

It is no secret that water attracts and holds life. This is true for many species of flora and fauna. Humans are no exception. Globally, roughly 40% of the human population lives within 60 miles of the coast (United Nations Ocean Conference, 2017). We are instinctively drawn to water, both man and beast. South Carolina is blessed with water resources, including an abundance of freshwater ponds. In this article, we will focus on management options to make your ponds more attractive and beneficial to wildlife. If we are to think of ponds as wildlife habitats, then we must consider not only the water but also the land tied to the water. Land which supplies water to the pond is as much a part of the wetland as the water itself. The health of aquatic systems is greatly influenced by the land feeding the system. Many use water quality as the standard for watershed health. If land feeding the pond is healthy, the pond should also be healthy. Healthy systems support a diversity of life.

Starting with the pond itself, we must understand that a healthy pond is not a pond free of aquatic plants. Aquatic plants and algae serve important roles in the wetland/pond system. Plants are primary producers and the basis for the food chain. Plants store carbon and oxygenate the water. Plants filter and accumulate nutrients. Aquatic plants provide structure and refuge for wildlife. A pond that lacks aquatic plant life is NOT HEALTHY. Management goals will determine which species of plants and the densities of plants that should be in the pond. Identify the species of plants in your pond, and investigate the value of those species for wildlife. This information will allow

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you to determine which plants are welcome and which are weeds. Managers looking to supplement their ponds with desirable aquatic plants will find a considerable collection offered by plant vendors. However, if you plan to add plant species, make sure the species is native and unlikely to become an invasive nuisance.

Aquatic vegetation is a critical part of a healthy pond. Photo credit: W. Cory Heaton, Clemson University.

Moving from open water toward the shoreline, we encounter the "emergent" zone. This zone is comprised of a gradient from shallow waters to moist soils. This zone is capable of supporting a diverse plant community and, thus, a diverse wildlife community. Broadleaf herbaceous plants, grasses, sedges, and rushes abound in this zone if allowed. These areas, when vegetated, provide food resources, escape cover, loafing cover, thermal cover, travel cover, nesting cover, and brooding or nursery cover for numerous species of wildlife. They also serve as a final filtration system for runoff water before it reaches open water. The importance of this zone to the habitat value of your pond cannot be overemphasized.

The moist soil area inland of the emergent zone is known as the "riparian" zone or the edge of the pond. The riparian zone also serves as a filtration zone. If properly vegetated, this area significantly slows runoff water and traps nutrients. These areas typically have fertile soils and are capable of supporting diverse plant communities. Pond managers should strive to maintain a diverse assemblage of plants in this zone. This area can support some plant and wildlife species common in the emergent and upland zones, in addition to species that seem to occur only in the riparian zone. Wildlife use these areas for foraging, traveling, loafing, nesting, and brooding. The value of these areas to wildlife is tied directly to the plant communities present. If you are interested in wildlife, then you should avoid planting these areas in turf grasses. Turf grasses will stabilize soils and help reduce the speed of runoff, but they do not provide much in terms of wildlife habitat. Pond managers often mow pond edges with the goal of maintaining the aesthetics of a well-kept lawn. Lawn-style management greatly diminishes the value of the riparian zone and the overall wildlife value of the pond. If allowed, natural vegetation will eventually dominate this area. You may also supplement the species present thru planting. Many species of herbaceous plants, grasses, sedges, rushes, shrubs, vines, and trees are suitable for riparian zone plantings. This edge habitat can be managed quite successfully without mowing. Spot spray applications of herbicides targeting woody stems accomplish the same goal of keeping the landscape open/non-forested without eliminating the habitat provided by the plant community. Targeted herbicide applications allow the riparian zone to perform its environmental and ecological services.

Managing the vegetation in the zones around your pond can ensure a healthy aquatic habitat. Photo Credit: W. Cory Heaton, Clemson University.

Drier soils upslope from the riparian zone are known as the upland zone. The upland zone is the first zone of filtration for runoff waters leading to the pond. In the absence of disturbance, the upland zone is or will become, a forested area. If healthy, the upland zone has a multi-layer forest with abundant flora diversity in the ground, mid-story, and canopy layers. Many upland landscapes have been changed to provide pasture, hay lands, agronomic crops, or development. Efforts can be made in these situations to ensure plant communities are established to handle runoff and support biodiversity while maintaining agricultural production. Soil testing, precision agriculture, and Integrated Pest Management will also help to reduce the amounts of fertilizer and pesticides that may translocate from uplands and eventually end up in your wetlands and ponds.

The health of each of the zones mentioned is directly tied to the plant communities that live within. The health of the pond is directly tied to the health of each of these zones. The value of the pond for wildlife is directly tied to the health of the pond. An understanding of these zones and their dependency on each other is critical to managing a pond for wildlife. The first step for a pond owner interested in maximizing the value of their pond for wildlife is to ensure that each of these zones is managed to promote diverse plant communities. When these zones are managed properly, wildlife will abound. Clemson University has a great fact sheet on management of these zones and restoring their representative plant communities (https://hgic.clemson.edu/factsheet/shorescaping-freshwater-shorelines/).

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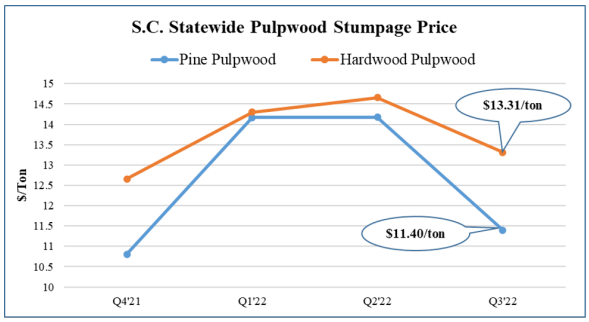
South Carolina Stumpage Price Trends and Inflation Basics for Forest Landowners

By Puskar Khanal

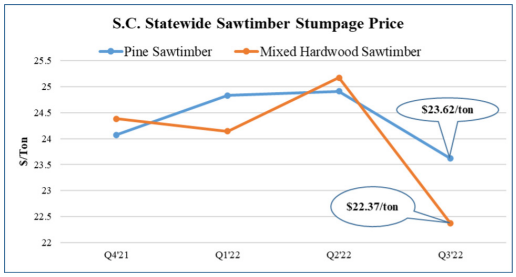
https://blogs.clemson.edu/fnr/2022/10/13/south-carolina-stumpage-price-trends-and-inflation-basics-for-forest-landowners/

Stumpage Price Trends

In the Third quarter of 2022 (Q3'22), statewide pulpwood stumpage prices for pine and hardwood declined after a steady increase in the previous two quarters. On average, the statewide pine pulpwood stumpage prices were $11.40/ton, a decline of 19% on a quarter-over-quarter basis but an increase of 12% on a year-over-year basis. Similarly, on average, the statewide hardwood pulpwood stumpage prices were $13.31/ton, a decline of 9% on a quarter-over-quarter basis but an increase of 14% on a year-over-year basis.



Graph of Q4'21 – Q3'22 S.C. Statewide Pulpwood Stumpage Price.



Graph of Q4'21 – Q3'22 S.C. Statewide Sawtimber Stumpage Prices.

On average, statewide stumpage prices in South Carolina were $23.62/ton for pine and $22.37/ton for hardwood trees in the third quarter of 2022 (Q3'22). The average pine sawtimber prices declined over 5% on a quarter-over-quarter basis, and the decline was about 2% on a year-over-year basis. Unlike pine sawtimber, the mixed hardwood sawtimber prices decreased approximately 1% on a quarter-over-quarter basis, and the decline was about 2% on a year-over-year basis. As shown in the figure below, hardwood stumpage prices declined more sharply than pine stumpage prices in the state. Hardwood stumpage prices were higher than the pine stumpage rates in the last quarter, but the trend has reversed this quarter.

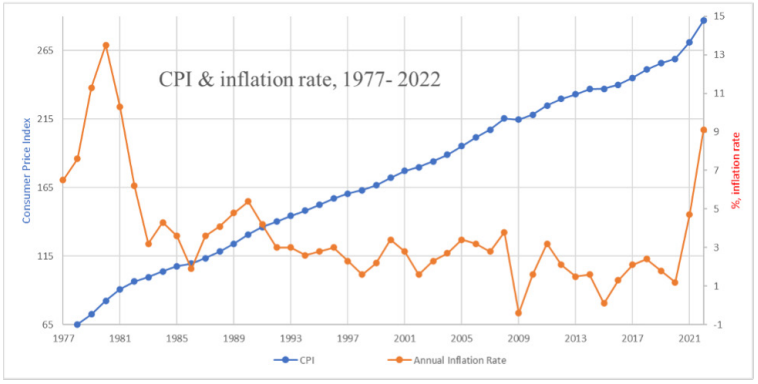
Data credit: The sawtimber and pulpwood price data included in this newsletter are published with permission from TimberMart-South Athens, GA 30605 email tmart@timbermart-south.com.

Inflation Basics for Forest Landowners

Inflation is at a 40-year high, and many forest landowners are probably wondering how this will impact their forestry investment. Timber is a hard asset, meaning it is tangible or physical and holds intrinsic value. Hard assets are usually considered hedges against inflation, and timber has been touted as an inflation hedge. The average price of gold has increased from $306 per ounce to a current rate of $1,722 per ounce between 1979 to 2022, indicating an increase of 462%. It would take $4.08 today to equal the value of $1.00 in 1979, or a 308% increase, to keep the same purchasing power. This is the idea of an inflation hedge, an asset that maintains its purchasing power over and above inflation. Gold is a hard asset and did manage to keep up with inflation and exceeded it.

The value of a dollar changes over time due to inflation, and as a result, a dollar today will not buy the same value of goods in the future. Inflation is a natural phenomenon in a market economy, and it refers to an increase in prices over a given period. Inflation affects everyone, including forest landowners, since it contributes to the reduction in the purchasing power of the U.S. dollar. Forestry and the business of growing trees have long been considered a good inflation hedge or a way to be immune to general increases in the overall price level. Savvy investors looking for inflation hedges could well outperform the market during inflationary times. Inflation-hedged assets help your portfolio thrive and grow even if inflation strikes the general economy.

Tracking Inflation over Time: The consumer price index (CPI) measures how much more expensive goods and services become over a specific period. CPI is just an index number that measures the value of commodities such as groceries, haircuts, milk, lumber, beer, etc.



Graph of CPI and Inflation Rate from 1977-2022.

This index is one way that we try to measure the dollar's purchasing power over time. Figure 1 shows historical Consumer Price Index (CPI) values and inflation rates in the U.S. between 1977 to 2021, with values shown on the left axis. The blue line increasing linearly from left to right is the CPI line, increasing smoothly over time.

Timberland hedge against Inflation: Many investors

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South Carolina stumpage price trends and inflation basics for forest landowners cont.

and analysts have suggested timberland as an important long-term investment category that could provide a hedge against inflation and preserve capital. A recent study has shown that forestland values tend to increase over time, keeping pace with inflation. From the comparison of prices for the five major timber products- pine sawtimber, hardwood sawtimber, pine pulpwood, hardwood pulpwood, and pine Chip-N-Saw, the study found that stumpage price only couldn't be considered as an inflation hedge. However, timberland assets that jointly consider three major factors – tree volume growth, stumpage price change, and land value in combination- could be considered a hedge against long-term inflation over 20 to 30 years. This study also suggested that pine pulpwood and Chip-N-Saw were better hedges than other product categories. If you do not earn, invest, or purchase anything, you don't have to worry about inflation, but it affects those buying forestland, making planting decisions, or selling their stumpage. It will impact timber prices and harvest revenue values. Timber revenues have to increase above the inflation rate to maintain their purchasing power. Revenue calculations without inflation might look like an attractive investment, but it may not be an increase if recalculated with inflation – this phenomenon is called the money illusion.

Landowners need to clearly explain financial expectations or any minimum rate of return expectations from their forestry investment to their consulting forests. It will help the consulting forester to evaluate options and use financial criteria to decide which seedlings to use, site preparation intensity to apply, and when to cut. Notably, inflation will impact the cost of forestry practices, such as site preparation, planting, and harvesting practices. Forestry costs tend to increase with inflation. It will further reduce the forestry rate of return in constant dollars for the landowners.

South Carolina Women in Agriculture Conference

South Carolina Women in Agriculture Conference
November 4–5, 2022
Connecting Women in Agriculture across South Carolina
Clemson, South Carolina

During this inaugural conference, the focus will be on connecting women in agriculture across the state with each other and providing educational information and resources they can use in the future.

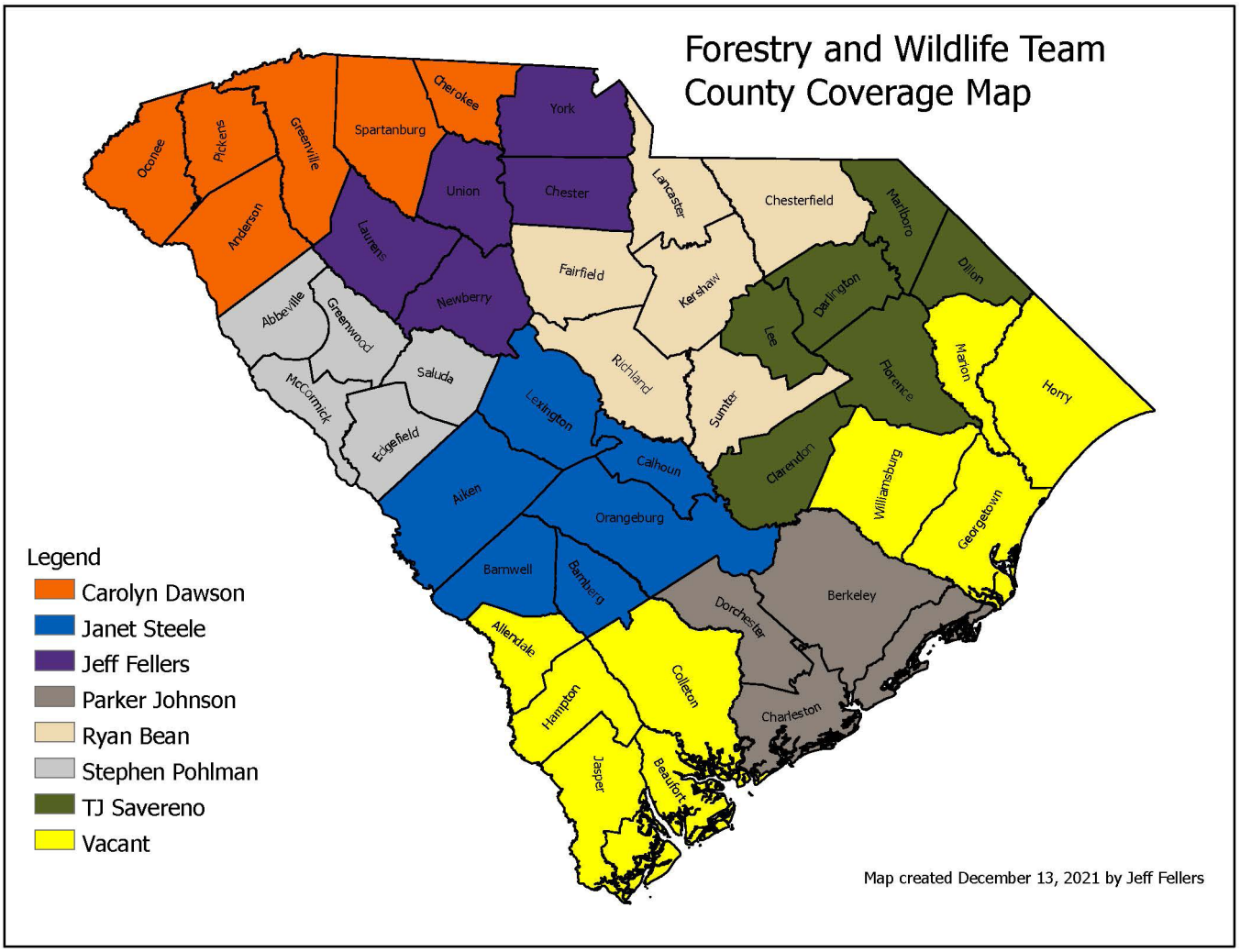
On Friday, November 4, attendees will be transported from T. Ed Garrison Arena's cattle complex to tours of Clemson University's LaMaster Dairy Center, Student Organic Farm and Agricultural Service Laboratory. A networking social will follow at 5:30 p.m. back at the Garrison cattle complex.

On Saturday, November 5, the conference runs from 8 a.m. to 5 p.m. at the Clemson University College of Business building on campus. There will be various educational sessions and presentations throughout the day from Clemson Cooperative Extension professionals and South Carolina producers including:

- Farm Income Tax Basics
- Agriwellness
- Financing Options
- Hydroponics
- Forestry 101
- Agritourism
- USDA NRCS (National Resources Conservation Service)
- Youth Agriculture Education
- Integrated Pest Management
- Clemson's Food2Market Program
- ... and more

Visit the conference website for additional details- https://www.clemson.edu/extension/scwgn/conference.html

The conference is open to any person supporting the mission and purpose of South Carolina Women in Agriculture Network (SCWAgN). Please contact Charley Maxwell at chmaxwe@clemson.edu with conference questions.



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Newsletters are archived online at:
https://www.clemson.edu/extension/forestry/newsletter/index.html

Newsletter edited by Jaime Pohlman and reviewed by Janet Steele

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