Pine straw management in the southeastern U.S.

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Southern Forest Health and Invasive Species Webinar

23 March 2022

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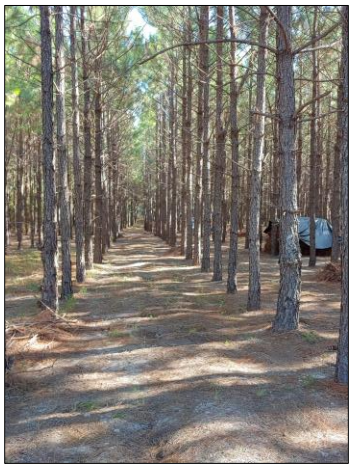
Presentation Outline

- Why pine straw?
- Economic and ecological values
- Species considerations
- How is pine straw raked and sold?
- Production factors
- Preparing a stand for raking
- Possible stand stressors related to pine straw raking



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Why Pine Straw?

- Uppermost forest floor layer of recently fallen, undecayed reddish-brown pine needles
- Straw used as a mulch for landscaping in certain areas of the country
  - Favored mulch in the South as it does not attract termites and low cost
  - Popularity as a mulch began in 1960s and 1970s and continues to increase
- Landowners with favored pine species can receive significant annual incomes from pine straw

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Economic and Ecological Values

- Pine straw's value as a forest product has been steadily increasing
- Recent annual reports from four southeastern states where pine straw is regular raked showed that landowners received over $225 million in revenue annually [1-4]
  - Value likely higher as reports do not exist in some states where raking occurs
- As pine chip-n-saw and sawtimber prices have remained relatively stagnant over the past couple of decades, pine straw revenues have helped landowners maintain cash flows to achieve attractive rates of return on their forestland
- Straw may represent the primary product for which a stand is managed for some landowners

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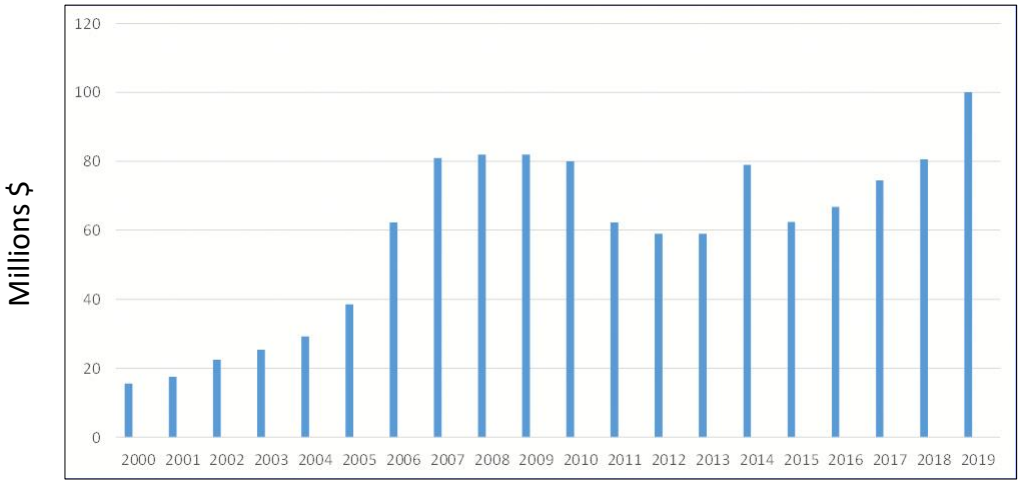
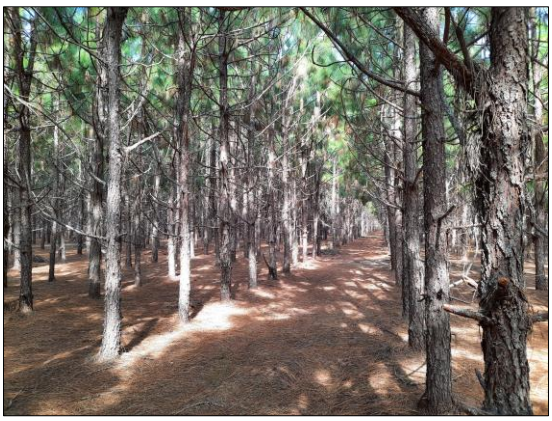
Economic and Ecological Values

Straw revenue paid to Georgia forest landowners



From Boatright and McKissick and Wolf and Stubbs 2001-2020 [1,5] A value increase of 6.5 fold from 2000-2019

Economic and Ecological Values



- Straw usually raked from canopy closure (ages 6-12 years) to first thinning or a clearcut (ages 15-23 years)
  - Depends on several factors
  - Straw production peaks about age 15 yrs
- Straw raked during stage of stand development where most pine plantations have little wildlife value other than possibly cover
- Lack of understory sunlight-reduces herbaceous vegetation diversity—comes with thinning and burning

Economic and Ecological Values

Prior to crown closure

Just after crown closure

After canopy closure

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Species considerations

- Straw production usually greatest with loblolly>slash>longleaf pine
- Example: loblolly=150-425 bales/ac, slash=120-375 bales/ac, longleaf=100-350 bales/ac –rectangular bales
  - There is no standard bale size
  - Modern mechanical balers often produce cylindrical bales of varying sizes
- Average rectangular bale dry weight is 16-18 (loblolly), 17-20 (slash) and 18-21 lbs (longleaf) [6,7]

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Species considerations

- Species with longer needles that degrade (lose color and structure) less quickly are preferred
  - Longer needles easier to bale
- Longleaf preferred over slash and slash over loblolly--needle properties
- Loblolly straw is seldom if ever raked
- Longleaf = highest demand, $0.70 to $1.25/bale
- Slash = 2nd to longleaf, high demand, $0.50 to $0.75/bale—slash straw may be baled less often as more longleaf acres come out of cost-share programs in coming years

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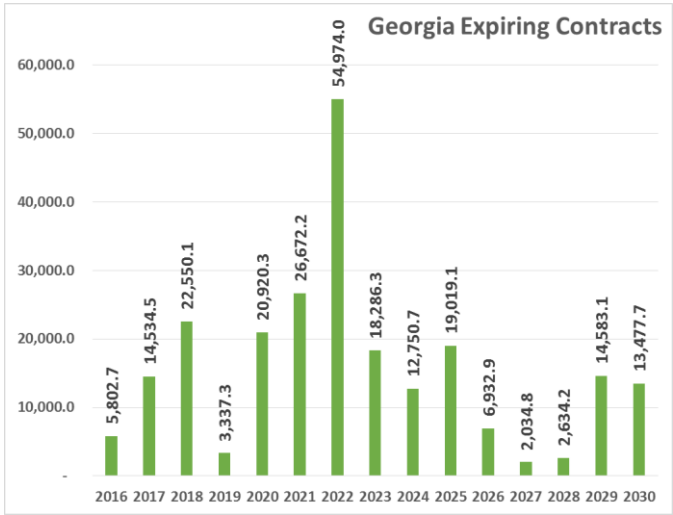
Species considerations

Longleaf acres exiting CRP contracts will exceed 100,000 ac during 2020-2022. Potential for lower prices for straw and less slash pine acreage raked. Trends may differ in other SE states



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Species considerations

Longleaf vs slash vs loblolly needle bundles

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How is pine straw raked and sold?

- Straw is either raked by hand or by machine
  - Pitch fork or yard rakes
  - Rake implement and bale machine
- Hand raking
  - Can be done throughout the year
    - Early to mid-fall ideal
  - 250 to 300 bales per day average for most three-person crews

https://www.agriquip.com/star/pinestraw_baling.html

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How is pine straw raked and sold?

After debris removal straw raked into piles

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How is pine straw raked and sold?

Straw may then be fluffed prior to baling

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How is pine straw raked and sold?

Straw is then ready for baling—usually homemade box balers with no standard set of dimensions

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How is pine straw raked and sold?

Bales are then gathered and hauled from the woods

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How is pine straw raked and sold?

- Mechanical raking
- Usually straw is mechanically windrowed between planting rows, picked up mechanically, baled, and pushed out to the side
  - Productivity can greatly increase over hand raking
  - 1,000 bales per day possible-less common method and productivity
- Mechanical raking capacity depends on site productivity, tree vigor, rakeable area, species, and equipment
- Larger acreages=greater returns

Straw windrow-would be followed by mechanical or hand baler

https://www.agriquip.com/star/pinestraw_baling.html

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How is pine straw raked and sold?

- Straw is sold to contractors by the bale or per acre
- It is best to sell straw as you would sell timber--sealed bid approach
  - Contract should specify both parties' conditions of sale
  - Landowner can specify items such as:
    - Access road maintenance/protection
    - Area to be raked-use a map with clear boundaries!
    - Times when straw can be raked (e.g. no raking during deer season) and time allotment to complete raking each year
    - Payment schedules
    - Access and trespass instructions
    - Where woody debris can be piled and/or burned in a stand
    - Etc.

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How is pine straw raked and sold?

- Selling straw by the bale
- Difficult to anticipate yields/earnings
- Paid for only those bales removed—accurate bale count required
  - Must trust contractor or be present daily on site to count bales
- Bale dimensions MUST be specified in the contract
- Revenues from selling by the bale may be greater than per acre

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How is pine straw raked and sold?

- Selling by the acre
- Lump sum sale—money is transferred up front
- More straightforward than by the bale sales—no guess work
- Usually best option for absentee landowners
- 3-5 year contracts common; per acre prices can be $100 to $400/ac+ depending on several factors

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Production factors

- Straw production depends on several factors
- Site history: old-field, pasture, or cutover—inherent soil fertility/tilth
- Stand basal area (stocking + tree size)
  - To a point, as basal area increases (after canopy closure) pine straw production increases
- Site quality
  - Fertility (in Coastal Plain closely related to land use history), soil moisture holding capacity, slope, soil tilth, etc.
- Raking intensity—periodic/annual and hand vs mechanical

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Production factors

- Mechanical vs hand baling
  - Mechanical bales heavier than hand baled straw-can result in fewer bales per acre with mechanical baling
- Percent rakeable area and debris loads
  - Contractors want stands free of vegetation and woody debris
  - 'Cleaner' stand will command higher price

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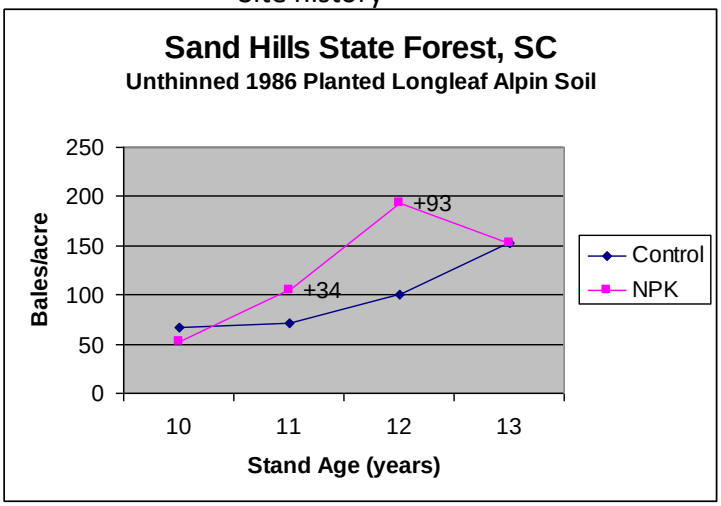
Production factors

Site history

Longleaf pine on cutover site with excessively drained deep sands

=moderate but-short-lived response to NPK



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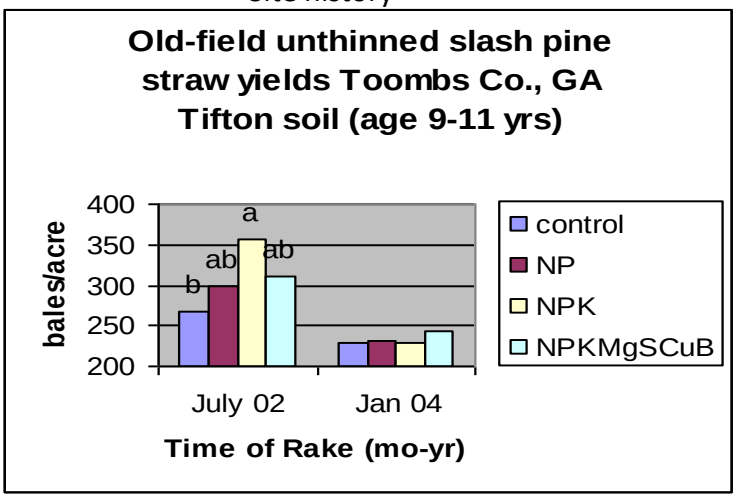
Production factors

Site history

Old-field site with moderate fertility

-One-year response to NPK
-No long-term fertilizer benefit



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Production factors

Site history

- On cutover, marginal fertility, low water holding capacity sites, pine straw yields can decrease for longleaf or slash pine without fertilization
- Fertilization can maintain or increase straw production over raked, unfertilized or unraked, unfertilized stands
- Slash pine (8-15 years old) straw production with annual raking on old-field sites does not respond to fertilization (90 N + 100P/ac or 200 N +50 P + 50 K/ac)

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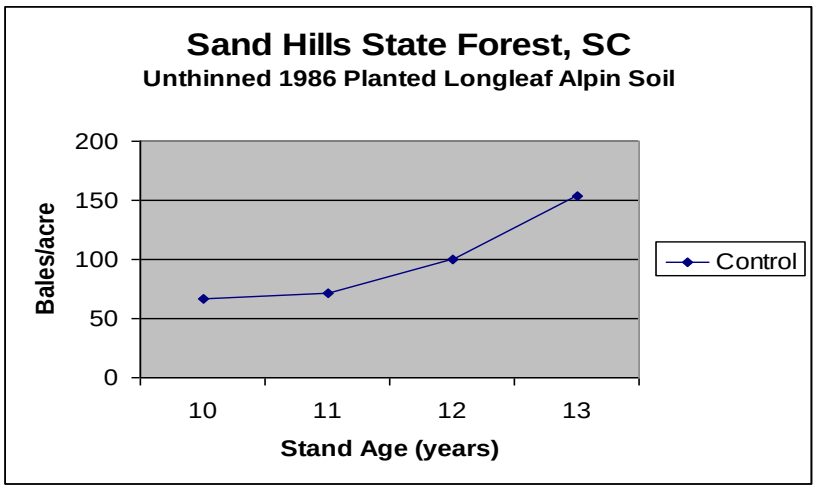
Production factors

Stand age relationship to straw production



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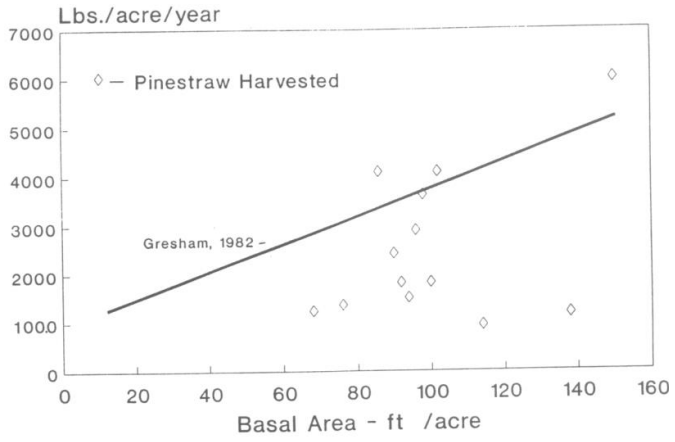
Production factors

Basal area relationship to straw production

The relationship between pine straw removals and BA can be poor

- Differences in raking timing and period of straw accumulation from year to year
- Site quality
- Tree vigor
- Pine species
- Stand age

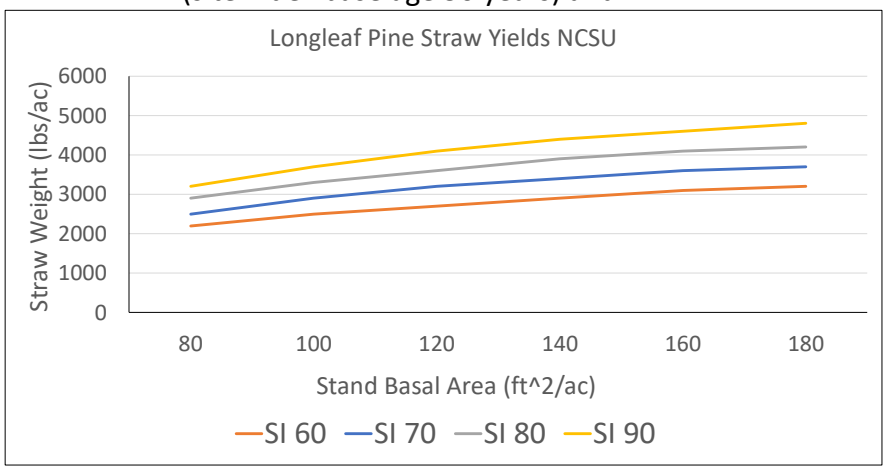
Less intensively managed stands



[6,8]

Production factors

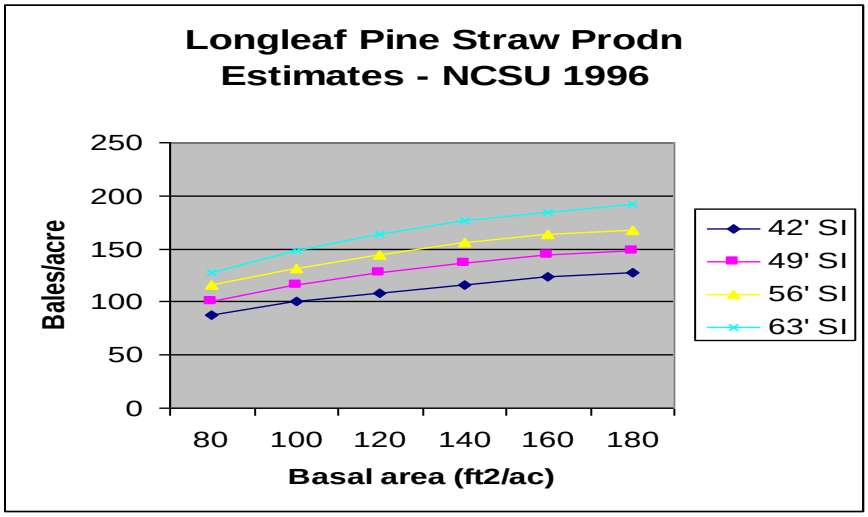
Longleaf pine straw production based on site productivity (site index base age 50 years) and BA



[7]

Production factors

Site Productivity and basal area relationship to straw production



[8]

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Production factors

Raking intensity

- In general, raking 2x/year > once annually (by 4-8%) > periodically (every 2 to 3 years)
- This may be the case only in the near-term
- More research needed on magnitude of effects on stand health, straw production and stand growth
- Hand raking is less likely to remove entire litter layer compared to mechanical raking and baling-less individual tree and stand stress?
  - More data needed on this

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Production factors

Rakeable Area

- 'Cleaner' stands have larger percent rakeable areas and command higher straw prices
- Some contractors will pile woody debris and apply herbicides with costs removed from landowner pine straw revenues
- Landowners can conduct these operations on their own 2-3+ years before an anticipated raking start date
- Preparation required will depend on site history, site preparation, herbaceous weed control and stand mortality rate

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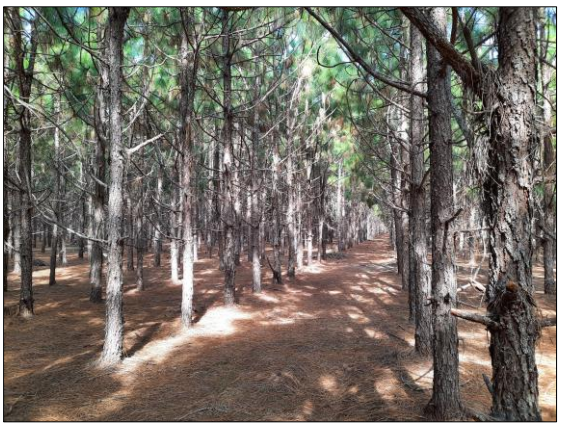
Production Factors

Stand clean-up conducted a couple to several years prior to raking results in greater straw yields (rakeable area) and prices



Stand preparation for raking

- Pine straw contractors want 'clean' stands free of understory vegetation and woody debris
- If straw raking is a management objective, preparing a stand for raking begins before trees are planted
- Good site preparation tailored to the soil and vegetation conditions on site can result in fewer maintenance stand entries in the future
  - Remember: age 0-3 years-herbaceous weeds compete more with pines
  - Age 3+ woody plants compete more with planted pines (need for good site prep)
- V-blade machine planting favors future raking
- 1st or 2nd year herbaceous weed control
  - Decrease time in grass stage for longleaf—sooner crown closure

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Stand preparation for raking

- Regular prescribed burning that ceases 2-3 years prior to the first rake can help with reducing biomass of understory vegetation
- Burns followed by herbicide spot spraying can be very effective
- Low intensity, winter burns often used

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Stand preparation for raking

Notice that this stand is at least a couple of years away from canopy closure

Stand preparation for raking

- Periodic mowing is another good option for preparing stands for raking
- Can begin as early as age 2-3 years
- Equipment should be chosen based on between row widths
- Mower attachment should be at least 2-3 ft less than average between row spacing
- Turn around space necessary at end of rows
- 25-30 hp tractor

Stand preparation for raking

- Herbicides can be very useful for stand preparation
- Preferred herbicides are typically foliar active only
- Should have forestry release label and list pine as a crop species
- Usually direct foliar applications—AVOID contact with pine foliage
- Certain vegetation may require different herbicides/application methods
  - Woody vines or large diameter hardwoods

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Stand preparation for raking

Pruning

- Pruning may be needed in mechanically raked stands
- Prevent limbs from striking equipment/operators
- Prune during winter months to appropriate height for equipment
  - Focus on lower, shaded limbs
- On branch whorls of 4 or more; prune half of limbs

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Stand preparation for raking

Rules of Thumb

- Do not allow competing woody vegetation to grow greater than 1-2" diameter or greater than 6-7' tall
- Removal using typical machinery becomes more difficult and expensive with larger woody stems—brush cutters needed for larger stems
- Use herbicides and mowing judiciously—try to delay chemical (herbicides) and mechanical (mowing) until just before canopy closure (usually ages 6-12 years) to reduce costs—need to create and keep access
- Some landowners may want to keep some understory vegetation—choose best method to preserve desirable vegetation
  - Landowners need to be aware that together raking and keeping wildlife friendly vegetation may not be optimal

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Stand preparation for raking

Application Scenarios

- Shorter/smaller weeds and woody vegetation (<4-5 feet tall)

1. Herbicide in summer (foliar active)—Be sure to use herbicides that are safe to use with the pine species present
2. Mow 60-90 days post-herbicide application
3. Stand may be ready to rake that winter

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Stand preparation for raking

Application Scenarios

- Tall/large weeds and woody vegetation scenario

1. Mow Mid-May to early February
2. Allow resprouting for 60-90 days
3. Apply foliar active herbicide during summer or fall
4. Mow again >60 days post herbicide application

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Possible stand stressors related to raking

- Stress considered “any factor that results in less than optimum growth rates of plants” that is “any factor that interrupts, restricts, or accelerates the normal processes of a plant or its parts” [9]
- Often portrayed as a stimulus that causes a strain
- Examples include: inter and intraspecific plant competition, low soil fertility, drought, wind, fire, insects, pathogens, pollution, etc.

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Possible stand stressors related to raking

- Environmental stresses often initiate a series of physiological dysfunctions in trees
- Tree growth and health responds more to water stress than any other perennial factor [10]

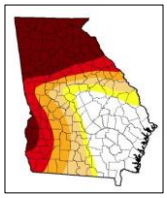
Severe long-term drought example

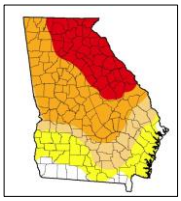
Drought inhibits absorption of water and mineral nutrients → **Decreased water absorption followed by stomatal closure, which over extended periods leads to reduced photosynthesis and growth hormone production** → **This environmental stress inhibits maintenance and growth of the roots, stem and crown which leads to greater likelihood of insect attack or disease**

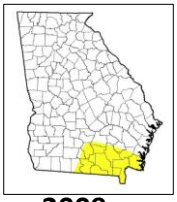
Possible stand stressors related to raking

Severe drought and hot temperatures during two periods in 2019 led to widespread *Ips* beetle infestations throughout southern Georgia

Possible stand stressors related to raking Drought


2007


2008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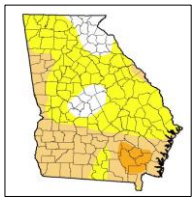
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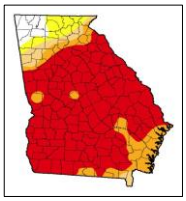
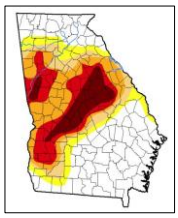
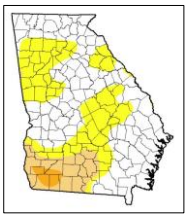
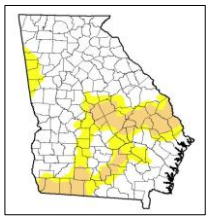

2011


2012


2013


2014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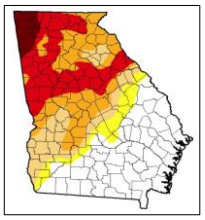
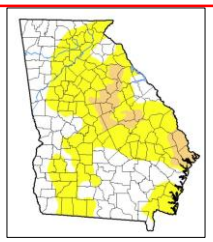
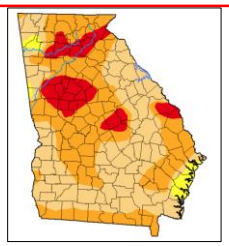

2016

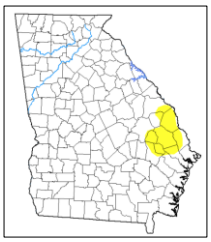
Second week of October

Possible stand stressors related to raking Drought


2017


2018

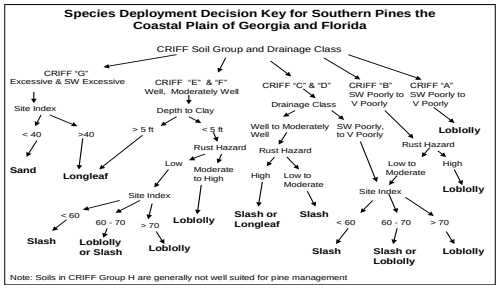

2019


2020

One year out of every three to four years about half of the state has drought conditions—an environmental stress we cannot control

Possible stand stressors related to raking

- Drought effects may be reduced with proper management
  - Matching pine species to site correctly—especially important on well-drained, drought prone soils
  - Thinning at the proper time
  - Proper vegetation control
  - Fertilization when soil and foliar tests show nutrient deficiencies



[11]

Possible stand stressors related to raking

- Studies have shown that more intensive raking results in added moisture stress to stands
  - Think of straw as a mulch that helps prevent water evaporation
- Avoid raking gray, partially decomposed needles-rake only fresh, red needles
- Rake only once annually on better quality sites
- Consider raking on a 3-4 year interval on low-quality sites
  - Deep sands (e.g. Quartzipsamments-Lakeland, Alpin, Kershaw, Foxworth, Fripp, etc. soil series)
  - Sites often have scrub oaks and other indicator plants
- Fertilization (especially phosphorous) may help with maintaining tree health on low productivity sites (not old fields)

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