

What to leaning & uprooted pines do after a hurricane

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- 40-90 ft tall pines with any lean: some will straighten up some will not after
- 1 – 2 yrs but will continue to live

Factors involved with lean pine recovery

- Amount of rain and overall soil moisture status (often close to saturated soils) prior to the hurricane hitting the pine stand
- Wind speed and duration (time) in the stand (possible 2 wind directions in cases in the eye – front end and back end of hurricane)
- Tree height class → taller trees are exposed to more wind than shorter trees and are generally more apt to break to lean
- How recently the stand was thinned → pine stands thinned in the last 2 yrs are more apt to have greater damage than stands thinned >2yrs prior to the hurricane

Factors involved with lean pine recovery

- Amount of rain and overall soil moisture status (often close to saturated soils) and wind after the hurricane hitting the pine stand
- Younger, unthinned stands tend to have much less damage than taller, older thinned stands (evident after Hugo in Sept 1989 and Michael in Oct 2018)
- Individual crown size → crowns act as sails on a sailboat → large crown trees, at least in young (5-15 yrs old) capture more wind and are more apt to lean than smaller (and often shorter) crown pines
- When wind speeds are 135 or 155 mph sustained (Sept 1989 Hugo and Oct 2018 Michael, respectively); it does not matter what pine species one has, loblolly, longleaf and slash pine will all have similar amts of damage (evident in Hugo and Michael)

Lean pines over 40 ft tall



- 40-100+ ft tall pines with any lean: very few (<1%) will straighten up after 1-2 yrs but will continue to live as long as degree lean is < 30 – 45 degrees from vertical

Lean pines over 40 ft tall



- L photo: 1 month after hurricane Matthew >85 ft tall loblolly with varying degrees of lean
- Rt photo: 2YA hurricane Matthew (Rt photo) 85+ ft tall lob, all but 1 straightened up
- Note last tree in L photo – if stem bend/sweep per 16 ft is > 3" then it is a pulpwood tree

Lean pines over 40 ft tall



- L photo: 1 month after hurricane October 2015 Matthew 70-80 ft tall loblolly with varying degrees of lean –no evidence of straightened up after 1-2 yrs, lean slash pines still living 4 yrs later
- Rt photo: 2 yrs after hurricane Matthew photo 70-80 ft tall slash – all still with lean

Lean pines >25-40 ft tall

leaning < 30 degrees from vertical = some will straighten up

30-45 degree lean = few will straighten up

45-60 degree lean = none will straighten up

> 60 degree lean = none will straighten up

(shorter trees = greater chance of straightening up)



30-40 ft longleaf (left photo) did not straighten after 1 or 2 yrs. While 25 ft tall slash pine leaning <30 degrees did some straighten up after 2 yr (right photo) → **Give these stands with 25-40 ft hts and <30 degree lean 1-2 growing seasons (much is known after 1st yr)**

Lean pines 15-25 ft tall

leaning < 30 degrees from vertical = some/most will straighten up

30-45 degree lean = few/some will straighten up

45-60 degree lean = none will straighten up

> 60 degree lean = none will straighten up

(shorter trees = greater chance of straightening up)



22-25 ft slash pines (left photo; leaning 45 and 60 degrees) did not straighten after 2 yrs. While 25 ft tall slash pine leaning <30 degrees did some straighten up after 2 yr (right photo) → **Give these stands with heights 15-25 ft tall and lean <30 degrees 1-2 growing seasons (much is known after 1st yr)**

Lean pines <5-15 ft tall

leaning < 30 degrees from vertical = most/all will straighten up

30-45 degree lean = most/all will straighten up

45-60 degree lean = some will straighten up

> 60 degree lean = most will NOT straighten up

(shorter trees = greater chance of straightening up)



Longleaf (left photo) did straighten after 1 growing season (middle photo) while young slash pine (right photo) with 75-80 deg lean will likely not straighten up →

Give these young stands 1+ growing season

Lean pines <5 ft tall → rules of thumb

leaning < 30-45 degrees from vertical = most/all will straighten up

45-60 degree lean = most/all will straighten up

60-80+ degree lean = most will straighten up

(shorter trees = greater chance of straightening up)



1 yr old loblolly leaning >45- 60 deg that straightened back up after 1 yr (left photo).

Rt photo 1-yr old loblolly with hole at base from hurricane Matthew tree straightened up after 1 yr.

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Left photo: 1-yr old loblolly w/ 45 deg lean from vertical post Matthew (Nov 2016 photo) that straightened back up after 2 yrs Right photo: 2 yrs post Matthew in Effingham Co,

Uprooted large pines

tops tended to stay green until spring (March-April) of following year
4-6 month salvage window for high value uprooted wood



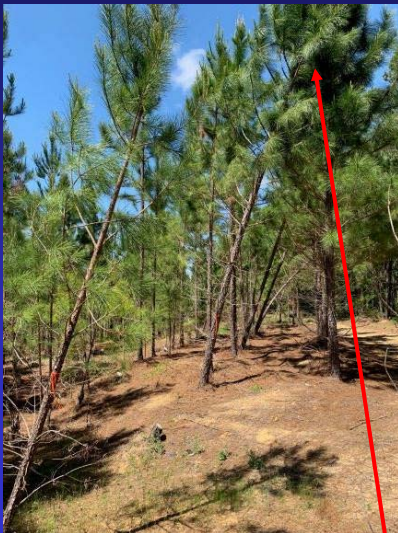
Late Oct 2016 after Matthew Bulloch Co GA

Uprooted loblolly pines post hurricane Michael –NE Laurens Co, GA



Photo taken 30 April 2019 after 10 Oct 2018 hurricane Michael - > 50% of trees are dead → 4-6 month window to salvage these trees before decay, but overall 60 ac stand had minimal damage

Leaning pine crowns in an adjacent pine crown



slash crown leaning into adjacent crown examples – some of these trees will die

Stem quality issues and hurricanes or tornados



- 9 Nov 2018 – 1 month post hurricane Michael (76+ mph max winds in this area)
- Photos: a high basal area slash pine stand (W of Hwy 221 about 1 mile on Hwy 86 in Treutlen Co)
- and poor stem quality → many cankered, forked and ramicorn branched trees
- Many trees broke at stem canker or fork → this stand is being clear cut as of early Dec 2018
- (most of stand is high and dry land in a very wet year so pulpwood prices in this area are high)

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Table 1. Timeline for timber to be salvaged to prevent degradation

Product	Harvest window*	Comments
Pine and hardwood veneers	4 - 6 weeks	Blue stain prohibits use if left longer
Pine dimension lumber	3- 4 months	Should be kiln dried to prevent emergence of secondary pests
Pine posts	4 - 6 weeks	Blue stain will affect toughness and preservative treatment
Pine and hardwood pulp, fiberboard, particleboard and OSB	6 - 8 months	As wood begins to decay, pulping process will be affected. Storm damaged wood should be mixed with sound wood

*The harvest window can vary due to several factors including but not limited to: time of year of the storm event, temperatures, rainfall, humidity and winds after the storm event. Once the bark starts to fall off the trees, the window to salvage and get some value is usually considered past.

Table 2. Timeline for invasion of damaging insects and diseases

Species	Year one	Year two
Pine	Bark beetles, ambrosia beetles, sawyers, blue stain fungi, soft rot fungi	Decay fungi
Oak and Hickory	Wood borers, ambrosia beetles, sawyers, soft rot fungi	Sapwood decay fungi
Other hardwoods	Wood borers, ambrosia beetles, sawyers, soft rot fungi	Sapwood and heartwood decay fungi

Lean pine summary

- Unless uprooted with much of the root system exposed to the sun, experience with Hugo (1989), Matthew (2016), Irma (2017), and Michael (2018) has shown that 90+% of the lean pines (loblolly, longleaf or slash pine) will live for 2+ years (most-all will live for a longer period of time) as long as degree lean for pines over 40 feet tall is <45 and for pines 25-40 feet tall is < 60
- giving forest landowners the chance to thin, clear cut these low to moderate damaged stands 1-2+ yrs later when pine stumpage prices rebound, or continue to manage these stands as they are
- Some pines will straighten up after one year but is a function of root damage evidence, tree ht, and degree lean
- Pines with crowns leaning onto adjacent pines crown will often die (possible reduced sunlight to that tree)

Questions



post Michael uprooted pines
15 Mar 2019 photo – Treutlen Co



Same stand clear-cut, photo 30 April 2019