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Subsoiling and Ripping to Prepare a Site for Tree Planting in the Southeastern United States

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Compacted soils limit transplanted tree root growth and future productivity on many sites. The use of ripping or subsoiling will reduce soil density and provide a channel for roots to grow deeper, improving tree survival and early growth. Ripping utilizes a curved shank tool about 18-32 inches long to cut a vertical slit about 2-4 inches wide on the planting row at least 8-12 weeks prior to planting, allowing time for rain to settle the soil (Photo 1). Subsoiling uses a similar shank tool with a wing at or near the bottom of the shank to fracture the soil, reducing soil density and improving tilth. Subsoiling should be done months prior to planting to ensure soil settling, as any air pockets will cause planted tree mortality. Both tools are mounted on a tool bar attached to a three-point hitch on a tractor or bulldozer. A hydraulic cylinder is used to raise or lower the tool bar and control the depth of the shank.

Photo 1: *A ripper tool with a "tooth" at the bottom approximately 2 ft long is shown. The ripper tooth provides some soil fracture and better tillage but not as much as the wings of a subsoiling tool. Common agricultural ripper tools have no tooth, just a straight shank. These do not provide as much soil fracture and may be used closer to planting time.*

Subsoiling or ripping is recommended where a hardpan has developed over time or in soils with high percentages of small cobbles (3 to 10 inches in diameter) to moderate sized stones (10 to 24 inches diameter). Hardpans and high rock volumes can restrict root growth, limit availability of soil moisture and nutrients, and reduce soil drainage. A hardpan is an impervious hardened layer that is typically high in clay. Different hardpans include a plow pan (from annual and repeated disking to a shallow 6- to 8-inch depth), traffic pan (common on pastures compacted by animals), and fragipans (some of our soil series are fragiudults, with an inherent hard pan). Most hardpans are found at a depth of 6 to 12 inches and vary in thickness.

Subsoiling and ripping are most effective in fracturing the compacted soil in hardpans or rearranging rocks in the upper soil layer when soils are dry. Ripping, and particularly subsoiling, when soils are wet will not provide soil fracture and may create a trench. Late spring and early summer are generally dry months and there will be ample time for the soil to settle prior to planting.

Subsoiling or ripping should be done on the landscape contour to minimize soil erosion and to a depth of 18 inches or more. On some soils with a strong hard-pan, two passes may be needed in the same subsoiled or ripped channels to obtain 18 inches or more depth. Proper horsepower tractors (in Photos 1-3 the tractor is 80 horsepower) or bulldozers are needed to pull the subsoiler or ripper at the needed depth, particularly in clay soils. Seedlings can be planted in the subsoiled or ripped rows as long as there has been enough soil settling time and there are no air pockets in the rip. If this does not happen, then seedlings should be planted to the side of the rip. Ripping or subsoiling has been found to also improve planting conditions in rocky soils.

The primary benefit of ripping or subsoiling hardpan soils is to provide openings in the pan that allow root growth into and below this dense layer or horizon. In addition, ripping or subsoiling tends to improve soil bulk density by lowering it, improve soil aeration and root development, and increase seedling nutrient uptake. Another benefit of subsoiling or

Photo 2: *The toothed ripper over 18 inches deep in the soil.*

Photo 3: *The toothed ripper after making straight line passes 10 feet apart.*

ripping as mechanical site preparation is it causes less exposed bare mineral soil, which decreases the chances of pioneer woody species from developing.

A number of studies have found improved pine and hardwood seedling growth with ripping or subsoiling compared to no ripping or subsoiling. Berry (1979) reported that subsoiling improved pine volume by 38% after five years in the Georgia Piedmont compared to no tillage. Shortleaf pine survival was improved by over three-fold, height growth by over 32%, and volume by 46.5% compared to the control after 20 years (Gwaze and others 2007). A loblolly pine site preparation study comparing a control (chop and burn only), ripping only, herbicide only and herbicide + ripping in southeastern Oklahoma was published in 1986. The study reported two-year loblolly pine groundline diameter and total height was significantly improved with ripping compared to no ripping (the control). The herbicide-only treatment two-year mean height and groundline diameter was greater than the ripping only treatment and the control. The herbicide + ripping treatment produced significantly greater two-year total heights and groundline diameters than all the other treatments (Wittwer and others 1986). These studies were all conducted on sites with soil hardpans and/or high rock volumes.

To determine if a site has a hardpan or compacted soil, walk the site after a one-inch or greater rain and use a drain tile probe or piece of 3/8 inch rebar to locate compacted soil (Photos 4 and 5). Push the probe into the soil in several locations where seedling planting is planned. If the probe goes into the soil at least 12 inches in all places, then a pan is most likely not present. Knowledge of prior tillage practices is helpful with decision making. Observation or the Web Soil Survey (https://websoilsurvey.nrcs.usda.gov/app/) soil mapping tool can be useful for determining rock content of soils.

Photo 4: *A drain tile probe can be used to see if a hardpan has developed on a site.*

Photo 5: *The drain tile probe metal rod has less than ½ inch diameter and a pointed end.*

LITERATURE CITED:

Barry, C.R. 1979. Subsoiling improved growth of pine on a Georgia Piedmont site. Res. Note SE-284. Asheville NC: USDA Forest Service Southeastern Research Station. 3 p.

Gwaze, D., R. Melick, L. McClure, C. Studyvin, D. Massengele. 2007. Effects of site preparation subsoiling and prescribed burning on survival and growth of shortleaf pine in the Mark Twain National Forest: Results after 20 growing seasons. Gen. Tech. Report NRS-P-15. Newtown Square, PA. pp. 129-133.

Wittwer, R.F., P.M. Dougherty, and D. Crosby. 1986. Effects of ripping and herbicide site preparation treatments on loblolly pine seedling growth and survival. Southern Journal of Applied Forestry 10: 253-257.