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What soil scarification does for germination of tree seeds

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Forests are complex ecosystems comprised of biotic (living) and abiotic (non-living) components. Forests change constantly because of the interrelationships of different ecosystem components and the timing of environmental events. Some forest changes are dramatic, while most are quite subtle.

Germination is the process whereby stored energy in a plant seed is reactivated. The resulting metabolic activity leads to the development of a seedling. For germination of specific plant species to be successful, certain environmental conditions need to exist. Consequently, some seeds may lie dormant in the soil for years, only to be reactivated when appropriate environmental conditions arise. Seed storage in the soil is referred to as the "seed bank."

Different tree species have different sizes of seed. Some tree species are termed "heavy-seeded" because their seeds are large and require the assistance of dispersal agents. American beech and red, white, black, and northern pin oaks are local examples. Blue jays and many other bird species can move acorns a long way. Rodents, such as gray, fox, and red squirrels, also disperse seeds farther from the parent tree than would otherwise occur.

Other tree species are termed "light-seeded" and produce very small seeds that can be dispersed significant distances by wind. For some light-seeded tree species that hold their seed into the winter, dispersal can be enhanced when seeds are blown across the crust that forms on top of snow; these tree species also function as natural winter bird feeders. Local examples of light-seeded tree species include paper birch, yellow birch, and ironwood.

Soil scarification is the process of preparing a site for seed germination by exposing mineral soil. And scarification can occur by different means. For instance, "windthrow" is the process in which whole trees are blown down. The result is exposed mineral soil where the roots once held the tree vertically in place. Windthrow is common on wetter or rockier sites because tree root depth is limited. Conversely, on drier sites with deep sands, fire can scarify the soil by removing the litter layer through the consumption of leaves (needles) and other organic matter. The resulting ash may function as fertilizer for seeds that germinate on the exposed mineral soil.

For some light-seeded tree species, such as paper birch, fire is critical. While fire may kill adult trees, it also prepares the soil for the next generation. Because paper birch seeds are small, they have little energy reserves and can desiccate quickly and become unviable if they fall on leaf litter. Fire removes the leaf litter and prepares a seedbed and increases seed viability. Not surprisingly, many natural fires occur in late summer and paper birch has evolved to drop seed in the fall or early winter when mineral soil is still exposed and moisture is abundant. Because of this, paper birch is one of the more fire-dependent tree species in Michigan. Fire suppression, along with climate change and secondary succession, has been reducing the abundance of paper birch in Michigan forests for decades.

Scarification can also be accomplished mechanically. Logging operations during the growing season can disturb the top layer of the soil when tracked machinery moves across the forest floor. And scarification can be enhanced when tree tops are dragged around the site. However, logging operations are not conducted during the growing season in many Michigan forests in an attempt to limit the spread of oak wilt. Oak wilt is a fungal pathogen that affects red, black, and northern pin oaks in our area. The pathogen moves below ground via comingled roots and above ground by beetles that respond to injured trees and carry fungal spores from tree to tree. To limit above-

ground spread of oak wilt, oak forests are often managed when snow covers the ground and beetles are inactive. During this time, soil scarification and its benefits are virtually nonexistent.

Forest landowners should consider the important role of soil scarification in some forest types. When done during logging operations, soil scarification can aid the development of diverse forests by promoting the establishment of many underrepresented tree species. Besides birch trees and ironwood, many pine species also regenerate better when scarification occurs. While eastern white pine seeds have the ability to regenerate across a range of soil types and even in the presence of a significant litter layer, red pine and jack pine benefit from exposed mineral soil.

The role of soil scarification in promoting successful tree germination is but one way in which the integration of biological and ecological concepts are incorporated into recommendations for managing for complex forests that are resilient and resistant.

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