

Pasture Improvement Tools

BIODRILLING BY FORAGE RADISHES



Forage radishes produce a nutritious, high yielding forage and large taproot capable of penetrating compact soil. The decomposition of the root in the spring creates an open conduit for water, air and the roots of other plants to penetrate deep into the soil profile. Seeding pastures with forage radishes may be a profitable remediation option for compact, or low quality soils.

Cattle can exert a great deal of pressure on the soil – more than three times that of an unloaded truck. Their treading compacts the soil, which restricts root growth, inhibits air and water movement, and decreases forage production. The use of “plant roots as tillage tools” may be a simple remediation tool. The roots of certain plants can penetrate or “biodrill” through compact soil. When the plant dies, the roots decompose and create vertical holes in the soil as well as cracks in pan-like layers of soil. These holes act as conduits for water, air and roots to enter the soil profile more easily the following spring and summer.

The most well studied and publicized biodrilling plant is the forage radish (*Raphanus sativus L.*). Because of its unique characteristics, the forage radish can provide many different benefits to the farmer, the soil, and the environment.

- **Rapid Germination and Growth:** It is a hardy plant that will establish rapidly under less than ideal conditions and reaches maturity in 8 to 10 weeks.
- **Large, deep, penetrating taproot:** It forms thick, white taproots reaching depths of 8 -16”. Radish roots penetrate deeper and are less affected by compaction than other common biodrilling crops.
- **Winter-killed and quick to decompose:** When the roots decompose, they leave holes in the soil which dry and warm the soil faster in the spring.
- **Roots rich in nutrients:** While the radishes are growing, their roots support and enhance populations of beneficial nematodes. Root decomposition releases nutrients into topsoil taken from farther down the soil profile.
- **Radish tops are excellent forage:** The radish tops provide a large quantity of highly digestible, carbohydrate and protein-rich forage in the autumn.

TIPS FOR GROWING FORAGE RADISH

ACQUIRING SEED

Forage radish (also called tillage radish) seed can be purchased for between \$2.50 and \$5.00/lb. Sources include Bird Hybrids, Lancaster Agricultural Supply, Ernst Conservation Seed (Cedar Meadow forage radish), and Seedway (GroundHog) among others.

PLANTING DATE

We recommend planting seeds in late June and early July. Try to time the seeding to be followed by rain.

BROADCAST SEEDING

Germination is challenged by healthy forage growth and reduced seed-to-soil contact. We recommend seeding a couple days before grazing (~ 5 lbs/acre). Grazing livestock decrease competition by other forages and incorporate seed into the soil. If a seed drill is accessible, its use is recommended. Forage radishes usually emerge within 3 days in warm, moist soil.

GRAZING THE RADISH

To achieve maximum benefits, wait at least 8 weeks before allowing cattle to graze the radish tops. If you desire multiple grazing, allow cattle to only graze the top one-third of the radish.

MORE INFORMATION

For more information about the Pasture Program's activities, contact Jennifer Colby, Pasture Program Coordinator, at (802) 656--0858 or jcolby@uvm.edu. UVM Center for Sustainable Agriculture, 106 High Point Center, Suite 300, Colchester, VT 05446



University of Vermont
19 Roosevelt Highway, Suite 305
Colchester, VT 05446

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KEYLINE PLOW-



Aerating soil without disturbing it seems like a magic trick. It is also the goal of Keyline plowing. A mechanical method to alleviate compaction, Keyline plowing is a subsoiling practice refined to avoid turning over soil and decomposing organic matter. Keyline plowing uses a specialized tool, a Yeomans plow.

The shanks of the Yeomans plow are narrow and have a shallow 8° angle to reduce soil disruption. Typically having 3 to 5 shanks, the Yeomans plow is recommended for use two to three times during the grazing season, over a two year period, for a total of 4-6 passes. The first pass is typically quite shallow, within an inch or two of the established root growth. Each pass is several inches deeper than the preceding pass, to reach a depth of 14-20" or more.

On each pass, the shanks slice into the soil, providing channels for increased water infiltration and root growth. A roller can be attached to follow the shanks, reducing surface disturbance. Seeder boxes can be mounted above the shanks, and seeding into the cuts is sometimes done to introduce new species and to enhance additional forage growth.

Subsoiling may increase carbon sequestration, especially on soils that have not been tilled for long periods of time (Purakayastha et al., 2008). This is presumably from a response in plant and root growth as well as in enhanced microbial activity.

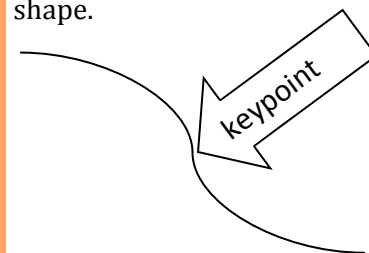
Farmers are pleased with the results of Keyline plowing, although we don't have data as yet. Looking at his plowed field, one farmer suggested "that there are real benefits to drainage and compaction." Another farmer saw stronger green color in the forage of the plowed field. There is some "bumpiness" on the surface as a result of the plowing, but the improvement seems worth it to the farmers who have tried it. We look forward to reporting the data.

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HOW KEYLINE PLOWING WORKS

Keyline plowing ideally follows the **keyline** of a landscape, the contour line that passes through the **keypoint** where the valley profile changes from a convex to concave shape.



The keyline has a unique geographic quality. Plowing parallel to the keyline, both above and below, will redirect water outwards and slightly down hill towards the ridges. This will more evenly distribute water, helping to drain the valleys and bring water to the higher regions, which are typically drier.

