Texas A&M AgriLife Extension

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DEEP SOIL RIPPING

as an Effective and Affordable Water Capture Tool

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Water Conservation Concerns

Drought is an inevitable consequence of climatic variability, and it is devastating for livestock producers. Dry cycles force us to focus on the critical need for landscape-scale water management solutions, especially in arid environments. Not only is this focus essential for the success of livestock producers, but it is also crucial for long-term efficient use of our water resources. A recent Sustainable Agriculture Research and Extension (SARE) Producer Grant examined the effectiveness of a management technique called deep soil ripping, or subsoiling, to capture and store water on the landscape, ultimately improving water capture on rangelands.

What is Deep Soil Ripping?

Deep soil ripping is the practice of pulling a subsoiling plow with a tractor to cut and open the soil. This practice can be used to try to alleviate soil compaction associated with previous management practices. Soil compaction is a concern for pastureland because it reduces rainfall infiltration, limits plant root growth, increases rainfall puddling and evaporation, and increases surface water runoff. Additionally, nutrient movement, organic matter, microbial populations and activity, and vegetative cover are all reduced as a result of the limitation in water cycling associated with compacted soils. Early subsoilers were highly disruptive to the soil surface, but newer technology such as the Paratill® or the double shank, the deep fracturing system used in this study, minimizes surface disturbance. Rather than overturning the soil surface, this method slices into the soil, much like a knife slicing through a cake, and fractures compacted soil below the plow zone. The applicator can be selective where he or she chooses to rip and may even combine ripping with fertilizer attachments to meet several management goals with just one pass of the tractor. This method is used in cropping systems but less frequently with perennial pastures.

Subsoiling plows range in price depending on design and availability, but the cost of implementing the technique used in this project is minimal. Expenses, excluding labor, are estimated at around $3.00 per acre and include fuel, depreciation, repairs, and maintenance.

A Deep Soil Ripping Case Study at Parker Creek Ranch

Site Description

Forty miles west of San Antonio, on a livestock ranch near D'Hanis, Texas, a Southern SARE funded Producer Grant research project was conducted to examine deep soil ripping as an effective and affordable water capture tool. Deep soil ripping had been conducted on areas across the property, and anecdotal evidence suggested positive effects.

To create a strong experimental design and establish both treatment (ripped) and control (not

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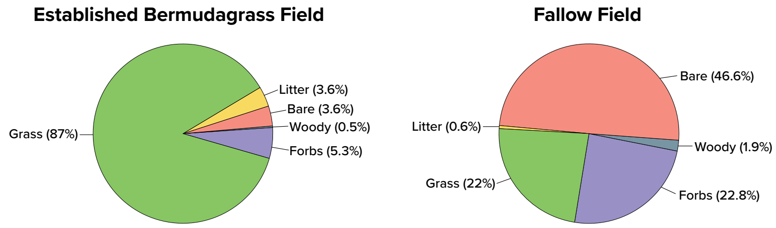

Figure 1. Comparison of ground cover prior to establishing ripping treatments (May 2018) for both the established bermudagrass field and the fallow field in poor vegetative condition, D'Hanis, Texas.

ripped) plots on relatively similar soils, a non-invasive electromagnetic induction instrument was used on two different study sites on the ranch—an established bermudagrass field and a fallow field in poor vegetative condition—to map soil properties (Fig. 1). The sites were approximately 4 acres each; neither site had ever received prior ripping, and soils of both sites are characterized as a Divot clay loam.

Deep Soil Ripping Technique

Prior to ripping, the contour of the land was determined using a laser leveler and flagged. Following these lines at intervals of 10 feet, treatment sites were ripped in August 2018 when the soils were dry to allow for deep fracturing. It is important to note the timing of the ripping event will depend on the location, soil type, and weather conditions. Ideally, soil moisture should be at 50 percent or less of field capacity, but not completely dry, to maximize shank depth and enhance water conservation. The subsoil plow used in this study was equipped with two 29-inch shanks that follow directly behind the 120-horsepower (HP) tractor tires.

A tractor pulling the subsoil plow equipped with two 29-inch shanks.

Soil Measurements

Loss of water through runoff and evaporation and the resulting reduction of soil water infiltration and root penetration are serious negative consequences of soil compaction. To better understand how soil ripping may improve these conditions, soil compaction was measured prior to and 1 year after ripping. Measurements included bulk density, or the soil's weight in a given volume, and hydraulic conductivity of the soil surface, or how quickly water can percolate into the soil at saturation. Hydraulic conductivity of the surface was measured using the single-ring constant head method prior to and 1 year after ripping. A chemical analysis of soil samples was conducted prior to ripping, and microbial and chemical analyses were conducted 1 year after ripping.

Vegetation Measurements

Ground cover includes bare ground and litter as well as vegetative components made up of grasses, forbs, and woody plants. Ground cover characteristics were evaluated prior to and on three separate occasions after ripping to assess the effects of ripping. Forage standing crop was harvested approximately 1 year after ripping to assess forage biomass (pounds/acre) and nutritive value (crude protein and digestible energy) for grazing livestock. Standing cover is important not only for grazing animals but

An example of plant response in strips where ripping occurred on Parker Creek Ranch, D'Hanis, Texas, allowing increased water infiltration.

also for wildlife because it acts as both nesting and hiding cover. The structural importance of standing cover was evaluated by measuring visual obstruction with a Robel pole method on three separate occasions after ripping. Photographs were also taken at fixed points prior to ripping and three times post ripping to visually document long-term changes in vegetative cover.

Highlights from Results

Deep soil ripping had the most significant impact on water infiltration. Fractures created during ripping allowed the low amount of rainfall received in this region to be more efficiently captured for vegetative use. Prior to ripping (Summer 2018), all sites had similar infiltration rates. Although ripped areas in both study sites demonstrated increased infiltration rates, ripping in the established bermudagrass site had a high initial vegetative cover (Fig. 1) and more than doubled water infiltration rates prior to ripping in 2018 (Fig. 2). The fallow field had less established vegetation to slow rainwater runoff and less root mass to break up the soil, preventing the increase in infiltration from being as high as the bermudagrass field.

Ripped sites had a lower bulk density, or less compaction, than control sites, but this difference was not statistically significant. Soil test reports from samples collected 1-year post ripping detected higher nitrates and ammonium in both ripped sites. The increased nitrogen could be from the disturbance influencing greater amounts of soil organic matter decomposition, and, therefore, greater nitrogen mineralization at the ripped areas. Active fungi were higher in control sites likely due to less short-term disturbance.

Deep soil ripping had no significant effect on the short-term vegetative ground cover type (Fig. 3) or the nutritive value of the forage. However, total pounds of vegetation produced in ripped sites were greater than in not ripped sites.

The Robel Pole method to measure standing biomass demonstrated a trend toward greater visual obstruction in ripped areas. However, there was only a significant increase in May and October on the fallow field (Fig. 4). This increase could have been related to tall forbs recorded on the ripped sites that were growing as a result of disturbance from ripping and a heightened effect in the fallow field where large amounts of bare ground were present. These forbs could provide both cover and a food source for wildlife.

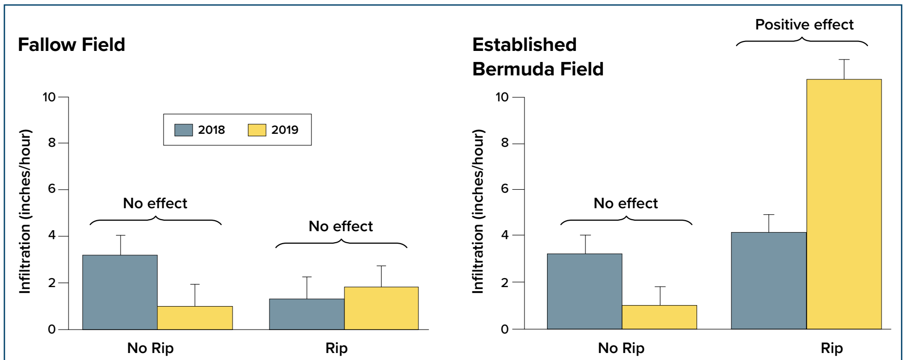

Figure 2. Infiltration rates (inches/hour) by field (fallow field versus established bermudagrass field) and treatment (ripped versus not ripped), prior to ripping in 2018 and after ripping in 2019, D'Hanis, Texas. A significant increase in water infiltration rate was found in the established bermudagrass field after ripping.

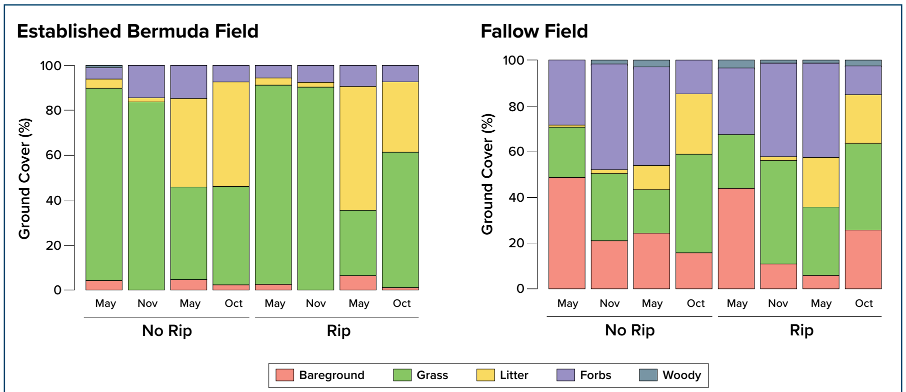

Figure 3. Ground cover from ripped and not ripped (control) treatments on the established bermudagrass field and the fallow field prior to (May 2018) and after ripping (Nov 2018, May 2019, Oct 2019), D'Hanis, Texas.

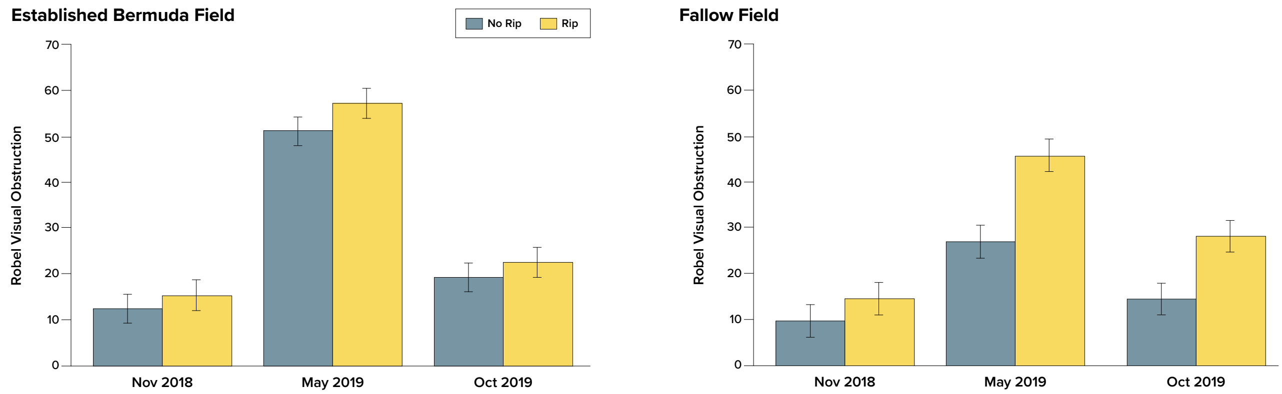

Figure 4. Vegetation visual obstruction (Robel Pole) from ripped and not ripped (control) treatments on the established Bermudagrass field and the fallow field, D'Hanis, Texas.

Summary and Recommendations

Strong evidence from this project and other related research indicate that deep soil ripping can be an effective method to capture and store water on landscapes because of increased rain infiltration. Although enhanced infiltration cannot make up for low organic matter, it can improve plant growth if other soil factors are adequate.

This research was conducted on two sites specifically selected to have similar soil textures (clay loam) to more precisely evaluate the effects of deep soil ripping. Other studies have found subsoiling methods to be most effective on heavy to medium-textured soils (clay and some loams). The required frequency of ripping on any given site may vary according to soil type, vegetative cover and response, and rainfall. It is best to allow vegetation to recover before grazing with livestock. Frequent subsoiling could have a negative effect on soil microbiology, structure, and vegetation. It is important to monitor soil and vegetative characteristics to assess the effects of subsoiling on soil water storage so that one can determine at what point the benefits of ripping have diminished. Responsible land stewardship is based on a proper frequency of soil ripping that accords with overall management goals.

Although ripping can increase rain infiltration, this study demonstrated the importance of prior vegetative cover by the multi-fold rain infiltration effects found in the bermudagrass field as compared to the fallow field. Poor vegetative cover is often the result of more critical soil characteristics, such as the lack of organic matter. It is important to address these other needs first before increased rain infiltration can be of value to the established plant community. Other tools, such as the addition of organic matter, may be better suited to help achieve your goals or may be needed in combination with ripping.

One thing is certain: with a growing population and greater pressures on our natural resources, such as soil and water, it is essential to find affordable and effective solutions to improve soil health and water quality. This research provides evidence that supports deep soil ripping as an effective method to increase the rate of infiltration, thus capturing and storing water across the landscape.

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