



# Paratill® Renovations of Pastures and Hayfields

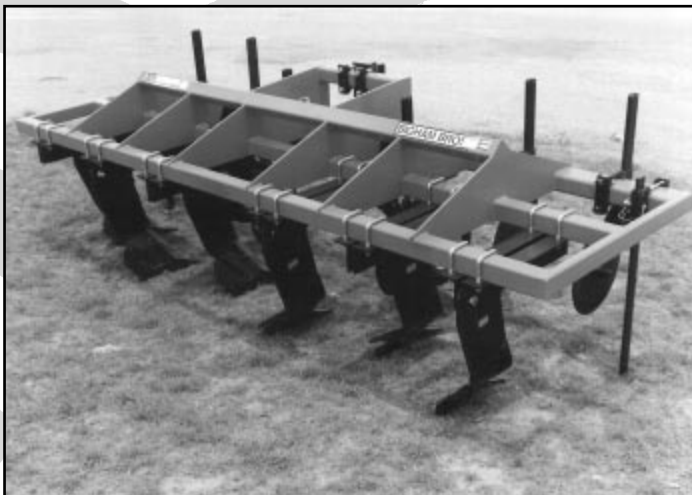
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A number of plows perform deep tillage, but few achieve acceptable results in re-establishing pastures without destroying major portions of the stand or creating considerable roughness.

One possible exception is the Paratill® Plow, which has been studied at several locations in Central and South Texas. This deep-tillage tool is equipped with coulters that slice through tight sod and plant residues. Following close behind are pairs of “legs” or stationary bottoms that are adjustable along a rigid toolbar.

The Paratill® Plow can:

- Loosen tight or compacted soils from 12 to 18 inches to increase root penetration and growth (select as needed).
- Leave the surface virtually undisturbed (established grasses and surface residues).
- Increase soil moisture storage (which translates into additional forage production).
- Improve internal drainage through the destruction of clay pans or compacted zones.



**Figure 1.** This six-leg Bigham Bros. Paratill plow illustrates pairs of legs facing in opposite directions on the tool bar. Fluted coulters slice the sod ahead of each plow leg. Gauge wheels provide assistance in determining depth of tillage.

In addition, the plow does not:

- Mix the topsoil with unfavorable subsoil.
- Bury surface residues important in protecting the soil.
- Create clods and roughness.
- Require additional trips for selected operations.

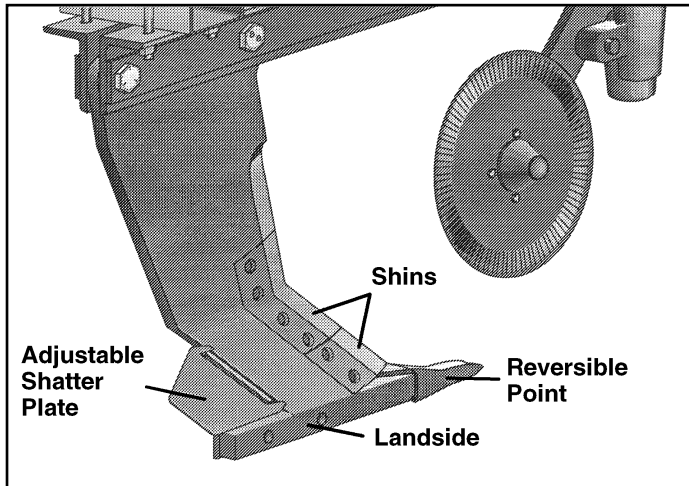
A fertilizer attachment to the back of the plow legs can be used to inject liquid fertilizer (such as deep phosphorous placement), instead of leaving it on the soil surface.

## Principles of Action

The Paratill® Plow leaves a smoother soil surface than a chisel plow, parabolic subsoiler, or V-ripper. While roughness is less, the result may nevertheless be unsatisfactory without a light disking. Soils that are deep-plowed when they are too wet or too dry will tend to gape or produce too many clods. To make it easier to work heavy soils that are not at optimum moisture, some units have been equipped with rear cultipacker attachments that will resettle the soil and breakup clods. If the results are unacceptable, field operations should be stopped until the soil is more suited to tillage.

The Paratill® lifts the soil instead of pushing it. It is best used when there is some soil moisture. This would be at 50 percent or less of field capacity, when the soil is well drained, but not too dry. If the correct conditions are present, the soil is lifted “in-place” and falls, leaving the sod fairly intact. The soil is under-cut about 50 percent of the linear surface and is shattered along many natural cleavage planes. When these conditions are present, there will be few, if any, clods produced that are larger than your fist. The drier the conditions existing at time of renovation, the larger the clods that will result. When conditions are too wet, plant residues (bermuda grass roots) cling to the cutting edges of the plow and soil begins to collect on the surfaces. This may also create gapping, smearing, and damage to the soil structure.

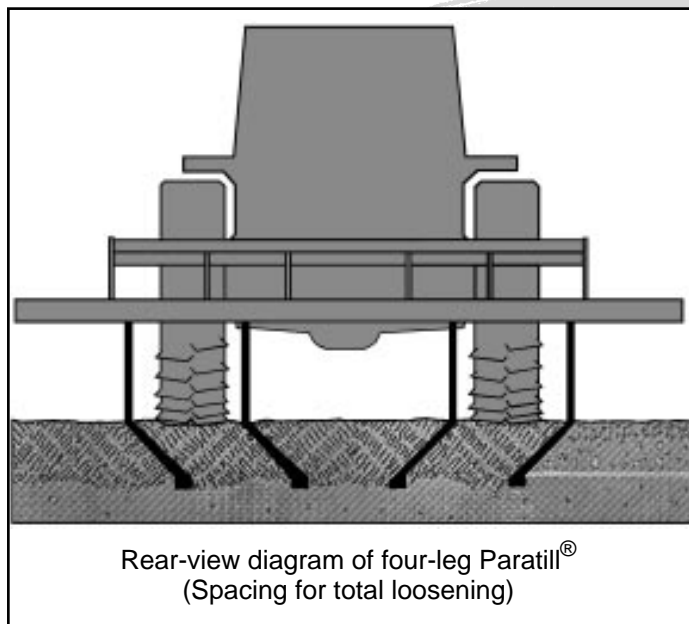
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**Figure 2.** Schematic diagram illustrating primary components of a Paratill® plow.

## Timing of Renovation

Selecting the best time to renovate has a tremendous effect on the user's degree of satisfaction. The best time for deep tillage is just before a rain. Ideally, the coastal bermudagrass would be winter-dormant at the time of renovation (December through March). If the outlook is for dry conditions, then renovation could have some risks. While bermudagrass has deep rhizomes and roots, it is possible that an extended drought immediately following deep tillage could seriously injure stands of any type of grass. Legs should be placed on the toolbar to undercut only 50 percent of the subsurface profile, leaving other roots disturbed but connective.



**Figure 3.** Spacing the legs on the tool bar can create either zone loosening of sod (renovation) or total loosening (reestablishment) of broken land.

## Benefits of Deep Tillage

Why invest \$15 to \$18 per acre in deep tillage? If you are noticing declining forage yields and weed encroachment, compaction has reduced the water storage and accessible nutrients in your soil. While substantial yield increases have been observed in renovated coastal bermudagrass, klein, and buffel-grass pastures, coastal bermudagrass has perhaps been studied the most, with these results:

- Forage nutrient values are higher in deep-tilled fields in all values except crude protein. This increase is due to a larger root zone from which the forage plants may extract nutrients and the additional water storage capacity to retain them as soluble nutrients.
- Treated fields remained green and growing 2 to 3 weeks after non-tilled fields had gone summer-dormant. At the beginning of a drought, this additional production is critical.
- Cattle are able to obtain more usable forage because there are fewer weeds and competing plant species. Forage is more palatable and intake increases.
- More applied fertilizer is used in years with declining rainfall.

## Forage Quality

Coastal bermudagrass often grows erect following renovation. Tillering and thickening of the stand with runners may be delayed until the soil has resettled with rain and hoof traffic. Forage testing of grass from renovated and non-renovated test strips has demonstrated higher TDN, protein, carbohydrate, and nutrient content in renovated plots. Not only is tonnage increased, the content of all desirable nutrients was increased as well. Such hay or forage is of much higher value to the livestock producer who produces hay for his or her own use. Premium hay reduces the amount of cottonseed meal or cubes required to overwinter herds and improves the performance of most cow-calf operations.

**Positioning Depth.** If a compacted layer is present, find it using a smooth rod. This works best when the soil is moist enough to permit probing. After finding the layer, push the rod harder until it passes just through the compacted zone. Mark the rod at this point and measure it with a ruler or tape. Adjust the depth of the plow point to be just one inch below the bottom of the compacted layer. Plowing to any greater depth is unnecessary, resulting in wasted fuel and additional power requirements.

## Power Requirement

All deep-tillage tools are power-intensive. Depending on the number of legs on a Paratill<sup>®</sup>, figure 30 to 35 HP for each leg. In addition, the tires should be in good condition (adequate tread) for traction. Plows have only CIII capabilities for hitching.

## Adjustments For Renovation

Once the depth has been established, the plow should be pulled into the sod to determine if it is level. The bottom of the plow should be parallel to the soil surface. If no hitch links require adjustment, set the gauge wheels to the desired height. If there is no plow pan or compacted zone, this can be 12 to 18 inches, depending on what is desired. After you ensure that all hardware is tight, the plow is ready for use.

## Plow Safety

Plowing deeper than normal can cause some surprises. Watch out for buried water lines, electrical conduits, oil lines, rocks, tree stumps, fence posts, and similar objects. If you encounter bedrock or caliche, you will want to reduce depth. In very stony fields that are used as hayfields, you may pull up more stones than can be easily removed. These fields should probably not be deep-tilled in preference for a shallow-tillage method.

## Plow Care and Maintenance

Coarse soils and very dry clay soils may cause greater equipment wear. It is not practical to estimate how many acres can be deep-tilled before point rotation is required, without relating such variables as soil texture and soil moisture. Points should be replaced when less than 4 to 5 inches in length. The rule of thumb is to rotate plow points every 350 acres when plowing loamy soil types. Points seldom last more than 500 to 700 acres.

Leg shins are fabricated as heat-treated forgings, while plow points are constructed from cast chromium carbide and will chip easily if stone or steel is struck in tillage operations. Cracked shins need not be replaced unless they become insecure. Most parts are lost through wear rather than breakage. Shatter-plate wear can be extended by "hard-facing." Plow damage can result if soft shear bolts are not used to set the plow legs.

The total plow weight varies depending on the number of legs positioned on the toolbar. A 4-leg unit weighs 3,530 pounds; a 6-leg unit weighs 4,650 pounds; and an 8-leg unit weighs 6,310 pounds. The most feasible method of moving the plow over large distances is with a Donahue- or Binkley-type equipment trailer. The plow should always be positioned just forward of the center of gravity of the trailer to prevent fish-tailing. Good hydraulics are required to lift the plow from the lowered equipment trailer.

## Field Management after Deep Tillage

The extent of additional forage obtained from renovated fields depends on the amount and type of rainfall received. If it is a year with abundant rainfall, then it is possible that no differences in forage production would be observed. If rainfall is intermittent, then there is greater storage capacity in the renovated field to collect and conserve the rain that is received. When a hoof pan or clay pan is limiting production, deep tillage could double forage yields for the first new production year. Subsequent years will show less of an advantage as compaction returns. Usually, after 4 years, an additional tillage operation is required to maintain favorable production.

Two 4-year pasture renovation studies were used to evaluate dryland and irrigated production with the Paratill. Under dryland conditions (Table 1), forage production usually resulted in more than 1 ton of additional yield with deep renovation, providing some rainfall occurred during seasonal production. Increases were greater in years when annual rainfall was below normal and showers were received for soil water storage early during the forage production season.

Table 1. Yields of Coastal Bermudagrass Obtained over 4-Year Study at Luling Foundation, Caldwell County, Texas, 1990-93.

Treatment	Forage Weight (lb./A.), by year				
	90	91	92	93	Avg
Tilled	3165	12202	11167	9230	8941
Untrd Ck	2088	9654	9232	7800	7193
Change	1077	2548	1935	1430	1747
% Inc	51.6	26.4	21.0	18.3	29.3

When rainfall was plentiful and irrigation was managed to perfection, forage production was not dramatically different between the tilled and untilled plots (Table 2, page 4). Even so, only a few growers are capable of perfecting irrigation timing and fertilization, and water quality is often poor in South Texas (salt). Therefore, only timely and optimum rainfall will perfectly offset the impact of tillage.

Rainfall was favorable in 1991 and 1993 at the Hidalgo County test site (Table 2), and only small differences were realized. However, 1990 and 1992 were less uniform years and flood irrigation was not sufficient. Nevertheless, from 1 to 2 additional tons of forage were harvested. The maximum amount of additional forage that could be realized with tillage and good management was not fully tested in these two studies. Forage increase could be more than 2 tons under certain growing conditions.

Table 2. Yields of Coastal Bermudagrass Obtained over 4-Year Study on 4M Cotton, Cattle, and Grain Farm, Hidalgo County, Texas, 1990-93.

Treatment	Forage Weight (lb./A.), by year				
	90	91	92	93	Avg.
Tilled	11037	111761	1862	9888	10991
Untrd Ck	7072	10496	9222	9793	9146
Change	3965	681	2640	95	1845
% Inc	56.1	6.5	28.6	1.0	23.05

When stocking rates are very dense and pastures are heavily used during wet weather, yield curves may decline sooner than the typical 4 years. For best results, a generous fertility program should always accompany pasture renovations.

## Other Options Possible

Horsepower requirements are large for deep-tillage equipment. Because ranchers and hay producers usually don't own large tractors and because it is difficult to justify the purchase of equipment that is used only once in 4 years, equipment leasing or custom operator services might be more cost-effective. Leasing rates vary widely across regions. Dealers report Paratill<sup>®</sup> leases for zone loosening at \$6 per acre, if the customer supplies the wear parts or \$8 per acre if the dealer replaces them. Rates for total loosening are higher. In general, rates of \$7 to \$10 for a 4-leg machine and \$9 to \$15 for a 6-leg machine (per acre) cover both types of renovation operations.

Acres per hour is calculated by taking the implement width times the ground speed divided by 10. Assuming 5 mph ground speed, a 6-leg Paratill<sup>®</sup> would cover 6.5 acres per hour, and a 4-leg machine would cover 4.25 acres per hour (widths 13.5 and 8.5 feet, respectively). Normal diesel consumption is about 12 gallons per hour.

## Frequency of Renovation

Both forage production and quality will be extended further with rotational grazing for shorter periods. This will reduce compaction over time and will permit faster regrowth. Renovation is not an excuse to bump up stocking rates or to overgraze the more palatable forage. It may require 1 to 2 months to receive enough rainfall to settle the soil after renovation. It is usually best to obtain 4 to 6 inches of new growth before turning animals back onto renovated grassland.

The Paratill<sup>®</sup> is built by The Tye Company of Lockney, Texas, and Bigham Brothers Inc. of Lubbock, Texas, and is patented. These plows have a place in renovating improved pastures and hayfields where there are deep soils and sufficient grass density to preclude a reestablishment.

For shallow soils, or soils recently reclaimed from brush or forest, the more acceptable method of breaking a hoof pan would include equipment that works a more shallow profile. Units like the Hay King and Airway have demonstrated acceptable results with more frequent tillage cycles. The lower power requirements of these units make moderate or shallow tillage accessible and practical, where deep tillage might be limited to only those producers with clean fields and large equipment.

## References

"Renovation Practices to Improve Rainfall Effectiveness on Rangeland and Pastures," C. Wayne Hanselka, S. D. Livingston, and David Bade, Texas Agricultural Extension Service publication L-5077, 1993.

"An Evaluation of the Tye Paratill for Renovation of Pastures," S. D. Livingston, Texas Agricultural Extension Service, TCB Special Report 661, 1993.

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