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 if the soil is not loosened properly. 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.

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- “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.”

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

<table>
<thead>
<tr>
<th>Treatment</th>
<th>90</th>
<th>91</th>
<th>92</th>
<th>93</th>
<th>Avg.</th>
<th>Tilled</th>
<th>Untrd Ck</th>
<th>Change</th>
<th>%Inc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forage Weight (lb./A.)</td>
<td>90</td>
<td>91</td>
<td>92</td>
<td>93</td>
<td>92</td>
<td>11037</td>
<td>11176</td>
<td>11176</td>
<td>11176</td>
</tr>
<tr>
<td>% Inc</td>
<td>6.5</td>
<td>28.6</td>
<td>1.0</td>
<td>23.05</td>
<td></td>
<td>7072</td>
<td>10496</td>
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<tr>
<td>% Ck</td>
<td>90</td>
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<td>% 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 at $7 to $10 for a 4-leg machine and $9 to $13 for a 6-leg machine per acre cover both types of renovation operations.</td>
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### Other Options Possible

- Horsepower requirements are large for deep-tillage equipment. Because ranchers and hay producers usually 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® 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 at $7 to $10 for a 4-leg machine and $9 to $13 for a 6-leg machine per acre cover both types of renovation operations.

### 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 if there is a rain after deep plowing. 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 cutplow attachments that will resettle the soil and break up clods. If the results are unacceptable, field operations should be stopped until the soil is more suited to tillage.

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Benefits of Deep Tillage

Why invest $15 to $18 per acre in deep tillage? If you are noticing declining forage yields and weed encroachment, consider reducing 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-till 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-tillled 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.

Power Requirement

All deep-till tools are power-intensive. Depending on the number of legs on a Paratill®, figure 30 to 35 HP for each leg. In addition, the tires should be in good condition (adequate tread) for traction. Plows have only CI3 capabilities for hitching.

Adjustments For Renovation

Once the depth has been established, the plow should be pulled into the soil 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 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.

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.

Coastal bermudagrass often grows erect following deep tillage, providing more usable forage because there are fewer weeds and competing plant species. Forage is more palatable and intake increases.

Surplus of grass weight can result if soft shearbolts are not used to set the plow legs.

Forage Quality

Coastal bermudagrass often grows erect following renovation. Tilling 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 TDM, 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. Premix 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 not too dry 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 this plow point to be just one inch below the bottom of the compacted layer. Positioning to any greater depth is unnecessary, resulting in wasted fuel and additional power requirements.

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.

Forage nutrient values are higher in deep-till 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-tillled 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.

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

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Tilled</td>
<td>3165</td>
<td>12202</td>
<td>11167</td>
<td>9230</td>
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<tr>
<td>Untd Ck</td>
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<td>9232</td>
<td>7800</td>
<td>7913</td>
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<tr>
<td>Change</td>
<td>1077</td>
<td>2548</td>
<td>1935</td>
<td>1430</td>
<td>1747</td>
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<tr>
<td>% Inc</td>
<td>51.6</td>
<td>26.4</td>
<td>21.0</td>
<td>18.3</td>
<td>29.3</td>
</tr>
</tbody>
</table>

When rainfall was plentiful and irrigation was managed rather than breakup, Shatter-plate wear can be extended by "hard-facing." Plow damage can result if soft shearbolts are not used to set the plow legs.

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 them. Wear can be extended by "hard-facing." Plow damage can result if soft shearbolts are not used to set the plow legs.

Once the depth has been established, the plow should be pulled into the soil 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.
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, and 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 crust 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.
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Power Requirement

All deep-tillage tools are power-intensive. Depending on the number of legs on a Paratill®, 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

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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.

Forage Care and Maintenance

Coastal bermudagrass often grows erect following deep tillage. 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.

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 700 to 1,000 acres.

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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 year of new production. 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.

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Changes in the amount of cottonseed meal or cubes required to overwinter herds and improves the performance of most cow-calf operations.

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, 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). Only small differences were realized. However, 1990 and 1992 were less uniform years and only timely and optimum rainfall will perfectly offset the impact of tillage.
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 if the soil is not properly suited to tillage. If the results are unacceptable, field operations should be stopped until the soil is more suited to 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.

There are several advantages to deep tillage. 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).
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The Paratill® Plow has been studied at several locations in Central and South Texas. This deep-tillage tool is equipped with coulters that slice through tight soil and plant residues. Following close behind are pairs of "legs" or stationary bottoms that are adjustable along a rigid toolbar.

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