Telogia Creek Conservation Tillage Project

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ABSTRACT

A Best Management Practice demonstration project on crop and pasture land in the Telogia Creek Watershed was conducted by making reduced tillage equipment available to farmers, establishing on-farm demonstration plots, and holding field days to demonstrate and evaluate reduced tillage, new conservation tillage and new subsoil tillage technology. An evaluation of a Dyna Drive, a new rotary surface ground driven cultivator, and a Terra Max subsoiler with a newly designed bent-leg shank was performed. Primary tillage demonstrations of the Dyna Drive revealed that this implement can reduce the number of trips required for soil preparation. In normal field conditions where 80 to 90% field residue exists, one pass of the Dyna Drive left an excellent seed bed while leaving 30 to 50% residue. The Terra Max subsoiler was successful in disrupting existing hard pans and reducing soil compaction. Substantial growth response was observed in winter annual and summer perennial forage plots where subsoiling was performed.

INTRODUCTION

The focus of this grant project was on Gadsden County and North Florida area beef cattle producers, although the project was not restricted to this audience. Best management practices (BMPs) for all sectors of agriculture are currently being evaluated and established because of federal and state mandates. The Environmental Protection Agency estimates that agriculture accounts for two thirds of non-point sources of pollution nationwide. One significant way to reduce non-point source pollution from farm fields is to implement a conservation tillage system. Livestock producers in North Florida often utilize conventional tillage equipment in the soil preparation for planting cool and warm season forages. The planting of forage crops generally involves a mulch tillage system that involves tilling the complete field surface with some type of tillage implement such as a disk harrow, chisel plow, turn plow, field cultivator, combination tool or rotovator. Often fields are left with little surface residue to combat wind erosion, water erosion, and the leaching of nutrients or chemicals. Cattle producers experience forage yield losses due to the constant treading of hooves that causes severe soil compaction in most soils. Many of the existing tillage systems do not go deep enough to disrupt soil hard pans. Project goals were to identify BMPs that reduce soil erosion improve water quality, reduce fuel consumption, while at the same time, improve soil health and crop yields.

According to the Natural Resource Conservation Service (NRCS), conservation tillage is defined as any tillage method that leaves 30% of the field covered with residue after planting. Previous research had demonstrated that the Dyna-Drive[R] (registered trademark of Alamo Group Inc., Gibson City, IL), described as a rotary surface cultivator that was designed in England and widely used throughout Europe, could produce a very level, small clod and residue protected seedbed (Smith, 1995). Studies have shown that quality seedbeds could be produced with one pass of the Dyna-Drive into corn *(Zea mays* L.) stubble (Smith, 1995.).

Subsoiling increases yields while doing minimal damage to soil strength, while conventional tillage creates significant damage to soil strength (Busscher et al., 1995.). Deep tillage that does not disturb surface residue or existing forages is needed in many Southeastern Coastal Plain soils to disrupt subsoil hard pans that restrict root growth (Khalilian and Hallman, 1996.). North Florida cattle producers have not established BMPs that reduce soil compaction and effectively disrupt hard pans.

MATERIALS AND METHODS

In the Spring of 1995, a cooperative project among the Gadsden Soil and Water Conservation District, Gadsden County Extension Service, Florida Department of Agriculture and Consumer Services' Bureau of Agriculture Water Policy, and Gadsden County

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NRCS was initiated. Grant funds were secured through the Florida Department of Environmental Protection's Section 319 Program to do a conservation tillage demonstration project in the Telogia Creek watershed and Gadsden County. The purpose of the project was to evaluate and demonstrate new technology and establish BMPs that enhance soil health and increase forage yield. A project goal was to show farmers how conservation tillage and deep tillage can reduce nonpoint source pollution from cropland and pasture land. The project ran from April 1995 to April 1997 and included a conservation tillage equipment loan program, field days, and tours.

A new, eight-ft-wide (8'7"), ground-driven, rotary-surface cultivator called a Dyna-Drive and a new bent-leg (parabolic and curved) three-shank subsoiler called a Terra Max (registered trademark of Worksaver, Inc., Litchfield, IL) was purchased to loan to farmers to allow them to evaluate reduced tillage practices on their farms. The Dyna-Drive is suitable for conservation tillage as well as conventional tillage and can be used for seedbed preparation, chemical incorporation, pasture renovation, and overseedmg. The Dyna-Drive is ground-driven and it is designed to be operated at six to eight-mph. A Tye (registered trademark) grain drill box (seeding attachment) with hydraulic-driven motor was attached to the Dyna-Drive to allow seedbed preparation and seeding in one pass. Seed tubes were designed to drop seed in front of the crumbler roller, just behind the twin rotor tines. The attachment of a seeder like this is not necessarily recommended by either company, the manufacturers of Dyna-Drive or Tye equipment. The project provided a custom operator who used a 110 PTO horsepower tractor to operate the equipment. Tractor power selection was based on soil conditions, depth of tillage, tractor speed requirements, and manufacture suggestions. The Terra Max subsoiler manufacturer literature states that their patented, narrow, helical shank design conditions the soil to a depth of 20 in, leaving soil structure intact. The Terra Max was set up with three shanks spaced at 30 in. The Terra Max was equipped with coulters to slice residue in front of the shanks and an attached roller-conditioner to level the raised soil after subsoiling.

Demonstration plots were established with the Dyna-Drive/seeder combination on crop land, pasture land and hay land. Plots were seeded with oat *(Avena sativa* L.), rye *(Secale cereale* L.), ryegrass *(Lolium multiflorum* L.), and clovers. Also, the Dyna-Drive was used to incorporate 'Alicia' bermudagrass *(Cynodon dactylon* L.) sprigs on cropland while simultaneously planting ryegrass.

Demonstration plots with the Terra Max subsoiler were established on temporary pastures where small grains are planted in the fall and annual crops are planted in the spring or native forages such as crabgrass *(Digitaria* spp.) are grazed in the summer. Deep tillage is not a common practice on these fields and pastures. Subsoil demonstration plots were also established on permanent pastures and hayfields, which were bermudagrass and bahiagrass *(Paspalum notatum* L.). An established bermudagrass pasture/hayfield was subsoiled in strips leaving non-subsoiled strips in the field and was followed by a 7-in-spacing grain drill (Dyna-Drive was not used here) where ryegrass and *two* varieties of clover, Cherokee Red and Dixie Crimson, were planted in the fall. The Cherokee Red *(Trifolium pratense* L.) and Dixie Crimson *(T. incarnatum* L.) were not *mixed,* however, the individual clover varieties were mixed with the same variety of 'Surrey' ryegrass and clover performance was also evaluated where subsoiling was and was not performed. A Dicky-John^{R} (registered tradename) Soil Compaction Tester was used to analyze soil compaction through out the upper soil profile, identify hard pan depths, and evaluate the before and after effects of subsoiling.

RESULTS AND DISCUSSION

Forty-four farmers utilized either or both the Dyna-Drive and the Terra Max through the loan program that paid about 65% of the equipment operation costs. Additionally, seven sites were donated by producers for the purpose of demonstrating and evaluating this equipment. The Dyna-Drive was used on approximately 300 a and the Terra Max was used on a little over 150 a. Gadsden County soils are highly variable ultisols and more sand content is generally the rule in the surface profile and clay content is usually higher in varying depths of these mostly mineral North Florida soils. Most of the farm land this equipment was used on was upland soils with loamy fine sand surface soils and sandy clay loam to fine sandy clay subsoils. A few fields had some loamy sands to coarse sand sections. Gadsden County is not typical for most Florida soils as it borders the lower Chattahoochee River Valley and its soils are typical of many Coastal Plains Soils found in Georgia.

Under these soil conditions, the Dyna-Drive performed well and the twin rotor tines that work the soil appear to not suffer from abnormal wear. Based on observational wear, the Dyna-Dnve tines will have to be replaced at about the same interval as a disk on a conventional disk harrow,.

The Terra Max subsoiler did not stand up as well under these soil conditions. After 150 a of use, three

sets of points had worn out and all three bent-leg shanks had worn out There was not a close-by representative for the Terra Max manufacturer and no one was aware that the manufacturer has a solution for this excessive wear. Worksaver Inc. Sales and Marketing Manager, Chuck Bellew, stated that the Terra Max should have been equipped with wear plates and chromium carbide points, which the company has to offer to be installed to the subsoiler shanks. Bellew stated that the Terra Max is getting about 800 a of use with the wear plates and chromium carbide points. With the wear plates installed, the shanks should get thousands of acres of use (Bellew, 1997, personal communication).

Farmers were well satisfied with the performance of the Dyna-Drive. The District NRCS District Conservationist sampled 10 fields where primary tillage was performed on a variety of cropping systems and found the surface residue to be above 30% and sometimes as high as 50%. In secondary tillage operations and where residue was less than 50% to begin with, surface residue did fall below 30%. Growers were extremely pleased with how level the Dyna-Drive leaves a field and how good the seedbed is after one trip over the field.

The Dyna-Drive was field tested on a cotton field in the fall of 1996. In rank cotton *(Gossypium hirsutum* L.) stalks of recently harvested cotton, the self-cleaning tines worked quite well where the cotton stalks were 5 A or less. Where cotton stalks exceeded 5 A or more, the stalk coverage and burial of large stems was not adequate in one primary trip. The stalks were still somewhat green and contained high moisture,. Had the stalks gone through a frost, the Dyna-Drive would probably have performed better in cotton residue. Compared to one pass of a disk harrow, the Dyna-Drive was better in cotton stalks. The cotton stalks had not been mowed The conventional tillage practice is the mowing of stalks which is followed up by discing. In cotton that has not been allowed to get excessively high or too rank, which usually causes severe lower boll rot and reduced yields, the Dyna-Drive may be a good implement for growers to consider. More research needs to be performed.

The seeding of winter small grains by simultaneously seeding with the attached (Tye) seeder met with mixed results. In the fall of 1995, nine fanners planted small grains for forage which were rye, ryegrass, and oats. A small seed clover attachment made it where clover could also be simultaneously planted. Four of the nine fanners interseeded clover. Plantings in fall 1995 proved successful and good stands were achieved. In the fall of 1996, 15 producers planted winter small grains with this combination seeder and tillage implement. There was a substantial dry period in October 1996, and mixed results were achieved. Some stands of rye, ryegrass, and oats were slow to establish and in some cases, undesirable plant populations or stands resulted. An inspection of the actual placement of *seed* in the soil and seed soil contact was evaluated. The placement of *seed* behind the tines and in front of the roller conditioner was not leaving a substantial portion of the seed at a satisfactory depth or with the appropriate seed to soil contact, particularly where moisture was marginal for germination. The broadcasting of rye, oats, or wheat in front of the Dyna-Drive appeared to be a better method. More uniform stands were achieved by spreading the larger seeded small grains prior to tillage. Observations of utilizing the attached seeding apparatus for planting ryegrass and clover met with better results. Also, in permanent pastures overseeded with the Dyna-Drive in the Fall, the bermudagrass or bahiagrass was quicker to reestablish in early summer as compared to conventional tillage. More research is needed before precise recommendations can be made for the practice of simultaneously seeding in combination with ground driven rototillers.

The Terra Max subsoiler was very effective in reducing soil compaction and shattering hard pans. The curved or bent-leg shank breaks up hard pans as it lifts the soil above the shank point. With a one-half (1/2)-in tip installed on the soil compaction tester, readings in most fields showed there was a definite hard pan at a 6- to 8-in depth. Prior to subsoiling, soil compaction of hard pans often measured above 300 psi. One subsoiling brought hard pan zone readings to less than 100 psi. The 30-in shank spacing seemed adequate, however, sometimes a complete shatter was not achieved between shanks. Communication with the manufacturer was made about this possible problem. Their suggestion was that in order to accomplish a more complete shank-to-shank disruption of hard pans, off-setting shanks, which they sell as an option, are the solution. The Terra Max tool bar is designed for two in-line shanks, one is installed behind the first. One shank would curve left and the other would curve right. These were manufacturer suggestions and more research is needed. All of the three shanks used in this project curved the same direction. A ridging effect was created at the shank soil entry locations in permanent pastures. The manufacturer stated this could be corrected by removing the gauge wheels which would create more down pressure ***on*** the roller-conditioner. It should also be well noted that it takes considerable more tractor size or horsepower to subsoil with bent-leg shanks versus straight leg shanks.

The Terra Max yield response in three test plots where subsoiling was compared to no subsoiling (other tillage seeding, and fertilization practices were identical) increased forage yield. In a I-a field that was strip subsoiled in front of the Dyna-Drive, only a slight marginal growth response was noticed in rye. In a permanent bermudagrass pasture, a dramatic growth *response* was observed where subsoiling was performed. A 9-in average height advantage was observed, although the grass height was somewhat up and down between the shanks. In the ryegrass-clover mix demonstration where subsoiling was followed by a grain drill, based on observatinoal results, total forage yield was about double or twice as much (ryegrass and clover) as the control.

CONCLUSIONS

Both implements tested appear to be good BMP candidates, while this equipment takes considerable power to operate, both actually reduced energy use in producing quality forage. The Dyna-Drive revealed that this implement can successfully reduce the number of passes needed for soil preparation in most field conditions. In compacted permanent pastures, The Dyna-Drive substantially outperformed conventional disk harrows in the pulverization of sod It leaves an excellent seed bed while leaving a higher percentage surface residue. Although more research is needed, it appears to be a viable BMP implement. The Terra Max subsoiler shattered hard pans, reduced soil compaction by asmuch as 200 PSI and exhibited substantial growth response. Because of improved internal soil characteristics, drainage, permeability and the amount of surface residue left, subsoilers of this design are worth considering as conservation tillage tools.

LITERATURE CITED

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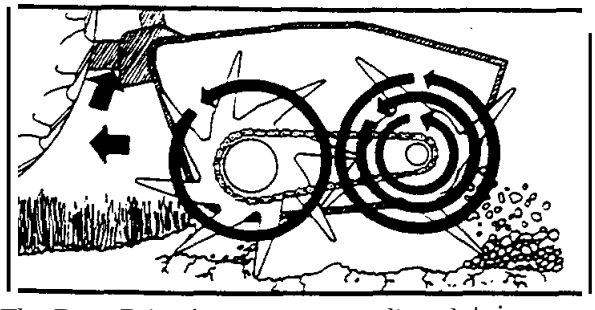

The Dyna-Drive is a very uncomplicated twin rotor ground-driven tillage tool that has no PTO or gearbox. The Dyna-Drive's front rotor is geared directly to the ground and drives the rear rotor with a heavy duty roller chain arrangement.