EVALUATION OF TILLAGE METHODS AND DEEP PLOWING

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Abstract

No-till, reduced tillage and conventional tillage were evaluated. Stands were more difficult to establish on the no-till and the reduced till was intermediate to the other two methods. Stand reduction due to Fusarium was greatest in the reduced till plots. Deep plowing was shown to be of benefit. The conventional tillage tended to yield less than the other cultural methods, however it was easier to establish a stand. In 2000 the reduced till plots were damaged more than the other treatments, especially the conventional tilled treatment. The stands were reduced due to fusarium wilt. The data does not suggest any tillage system to be clearly superior except deep tillage. Water stress is reduced by deep tillage. The largest advantage of no-till is the savings in equipment costs. The results show that the deep tillage loosens the soil for more than one year. The conventional tillage produced short fibers. Deep plowing increased the fiber length.

Introduction

Producers are faced with the continuing problem of reducing production costs while increasing or at least maintaining lint yield. They are either attempting to reduce tillage or eliminate it entirely. Some are attempting to control weeds chemically and not till the soil. Others are trying to maintain the old seedbed but till the furrows.

Many of the fields in the Missouri Bootheel have a hardpan that extends from five to fourteen inches deep. This results in the crop showing water stress shortly after a rain or irrigation. Irrigation only relieves the stress temporarily. Many producers since the advent of herbicides that had made burying weed seed unnecessary have discontinued deep tillage. Some producers are using the paratill plow to eliminate the hardpan.

Discussion

The trial was begun in 1997 comparing the three tillage methods. Deep tillage was evaluated only under the reduced tillage method. The trial was continued in 1998 through 2000. The deep tillage was performed every year in the spring. After the first year due to the results showing such a high yield response the test was enlarged to include a trial in another field to include the deep tillage in each of the three farming methods. The deep tillage in this field was done only in the spring of the first year in order to determine the value of deep tillage with each farming style and evaluate the feasibility of deep tilling only ever two or three years. The treatments were maintained on the same plots from year to year in order for the no-till soil to reach an equilibrium soil condition and for the deep tillage effects to be confined to the treated areas.

The trials were set up as a randomized complete block using four replications. The plots were eight rows wide. Stoneville 474 was the variety planted and all plots were irrigated as needed. In the month prior to planting a burndown herbicide was used to control weeds that emerged during the winter and spring. After crop emergence, it was found that a hooded sprayer was needed on the no-till plots if a herbicide resistant variety was not used. The problem weed species varied from year to year. Plains coreopsis, trumpetcreeper, honeyvine milkweed, and morning glory were the primary weed problems. With practice these became easier to control.

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The deep tillage was conducted in the spring using a paratill plow. It was very important to have two shanks enter the ground on non-wheel track rows and not have any enter the ground on the wheel track rows. In a wet year the picker will try to follow the shank entry channel if it is in a wheel track row.

The no-till plots were difficult to plant. The planter had to have coulters mounted in front of the disk openers and extra springs mounted to increase the downward pressure applied to the opening disks. It was difficult to get the opening furrow deep enough and for it not to vary in depth. The first two years a coulter was used an eight-wave disk. It caused the planter to fluctuate in depth as the opening disks rode over the wave trench. The third year a fifty-ripple coulter was used and it eliminated most of the variation in planting depth. However it continued to be more difficult to establish a stand in the no-till. The stand establishment in reduced till usually was intermediate to the no-till and the conventional till. In 2000 after a period of wet weather following emergence Fusarium wilt had a large affect on the stand. The stand reduction was much greater in the reduced till treatments as shown in figure 1.

Test plots were harvested with a two-row picker. The seedcotton samples were ginned on a twenty saw Continental gin stand preceded by an inclined cleaner and feeder-extractor. The gin stand is followed by one stage of lint cleaning. Fiber samples were graded on a high volume instrument. The no-till and reduced tilled plots had the winter weeds burned down in the weeks prior to planting.

In field 10 where paratilling was conducted, the yields were always increased by the paratilling as shown in table 2. In field 6 paratilling helped the yield in all three tillage methods (tables 3 and 4). After the first year the paratill was not used in this field and the advantage of the paratill was lost in the no-till plots. In the third year the advantage of the deep tillage was lost under no-till and reduced tillage. These results imply that deep tillage should be done at least in alternate years. The greatest advantage for deep tillage is under the conventional tillage system. However the penetrometer data indicates that the soil remains loosened for more than two years as shown in tables 5-10. The soil is loosened most under the crop and remains the most compacted under the tire track. The trials were irrigated but during dry years the deep tilled plots did not show water stress as quickly as the other plots. As shown in figures 11 and 12 the soil is very loosened when deep tilled every year.

The yields do not show any clear advantage of any tillage method. Usually the conventional was not best. The trend appears to show that no-till will usually perform well and it will have an advantage of using less equipment. However, more chemicals will be used. There were no major problems with reduced till except in 2000 where Fusarium greatly reduced stands. If one has a problem with weeds then the conventional would probably be best.

Tillage method had little influence upon fiber properties except length. The conventional tillage produced shorter fibers than the other two methods (figure 13). The fibers were longer when deep plowing was practiced. This was probably due to the reduced water stress.

In 1999 weights of plant parts were taken in field 10. The roots were significantly longer in the deep tilled plots. Numerically the data showed the root length to decrease as tillage was increased.

Summary

Deep tillage showed to result in higher yields under all three tillage methods. However the benefit decreased with the decrease in tillage. No tillage method showed to be clearly superior to the others. The conventional tillage tended to yield less than the other methods but it was easier to establish a stand in conventionally tilled fields. The most difficulty in establishing a stand was in no-till plots. It was difficult to plant the seed deep enough and to prevent some seed from being planted shallow. In 2000 the reduced till plots had severe problems with fusarium wilt early in the growing season and stands were greatly reduced. The weed problems in no-till and reduced till changed from year to year. Penetrometer data shows the soil to remain loosened for more than two years after the deep plowing. Fiber length was shorter when using conventional tillage or when deep tillage was not practiced. The main advantage of no-till is the elimination of much of the need for high horsepower tillage operations except for the deep tillage.

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References

Baker, S.H. 1987. Effects of tillage practices on cotton double cropped with Wheat. Agronomy Journal 79:513-516.

Ben-Porath. and D.N. Baker. 1990. Taproot restriction effects on growth, earliness and dry weight partitioning of cotton. Crop Sci. 30:809-814.

Bouquet, D.J., G.A. Brietenbeck and A.B. Coco. 1995. Cotton yield and growth responses to tillageintensity and cover crops. Conservation Tillage Systems for Cotton – Arkansas Agricultural Experiment Station – Special Report 169.

Kennedy, C.W. and R.L. Hetchinson. 1996. Cotton growth and development under different tillage systems. pp1234. Proceedings Beltwide Cotton Conference.

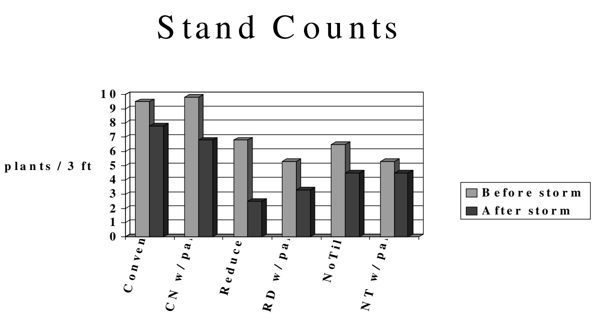

Figure 1: Stand Counts Before and After Hail and 4.8" of Rain.

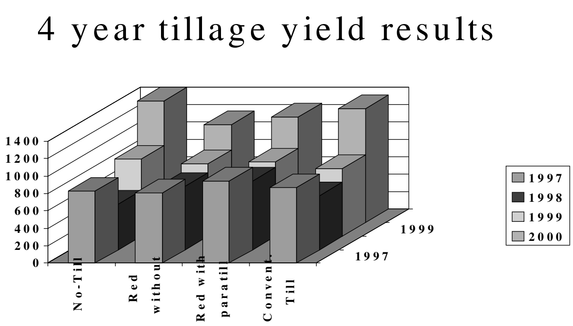

Figure 2: 4 Year Tillage Yeilds.

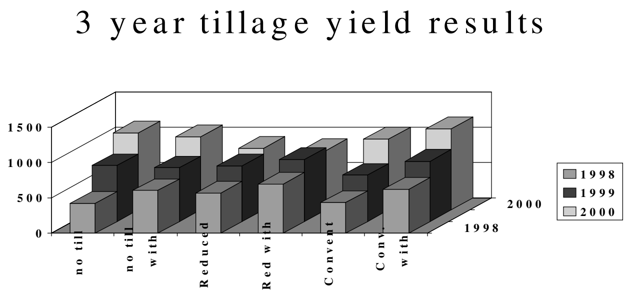

Figure 3: 3 Year Tillage Yields.

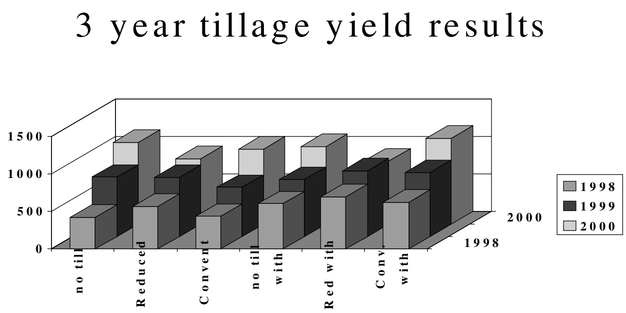

Figure 4: 3 Year Tillage Yield.

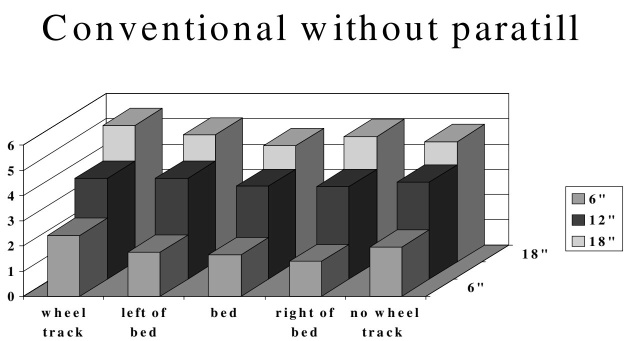

Figure 5: Compaction Results with Pentrometer Paratilled 2 Years Ago.

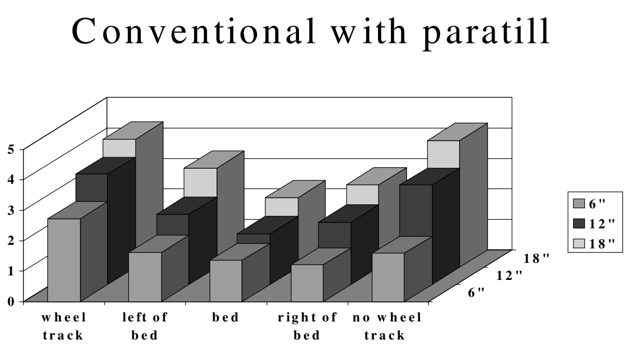

Figure 6: Compaction Results with Pentrometer Paratilled 2 Years Ago.

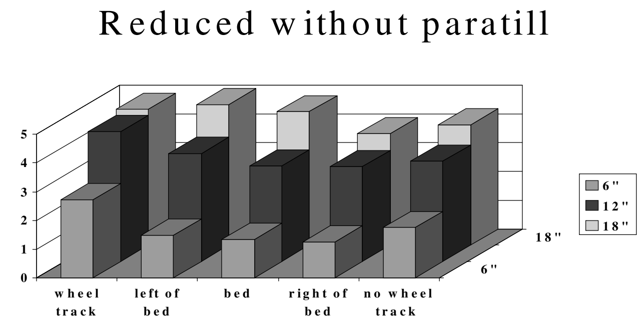

Figure 7: Compaction Results with Pentrometer Paratilled 2 Years Ago.

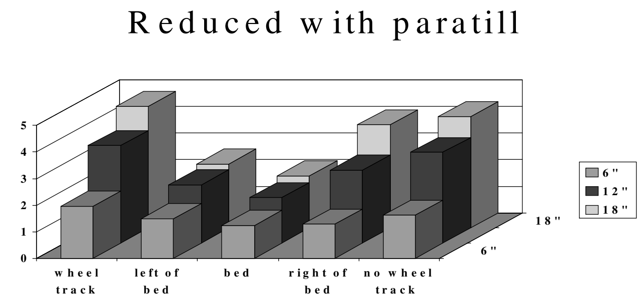

Figure 8: Compaction Results with Pentrometer Paratilled 2 Years Ago.

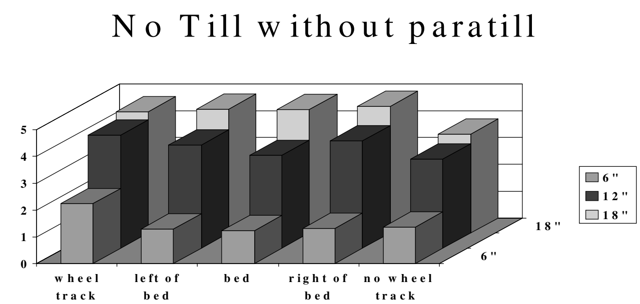

Figure 9: Compaction Results with Pentrometer Paratilled 2 Years Ago.

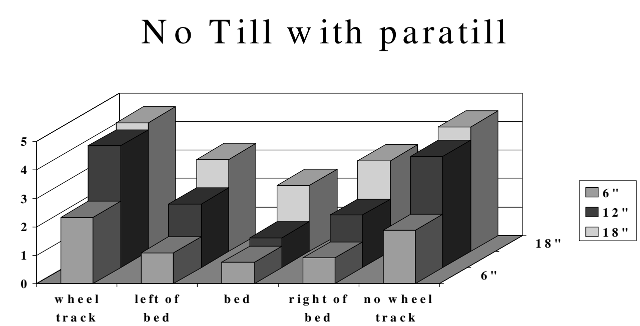

Figure 10: Compaction Results with Pentrometer Paratilled 2 Years Ago.

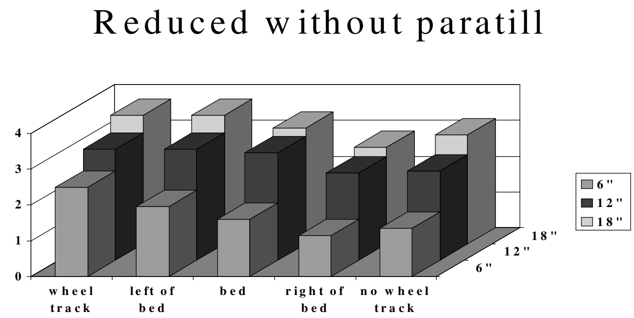

Figure 11: Compaction Results with Pentrometer Paratilled Every Year.

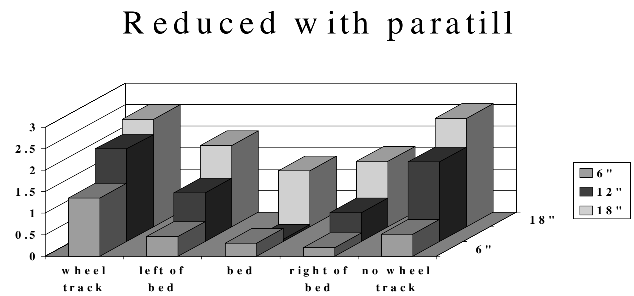

Figure 12: Compaction Results with Pentrometer Paratilled Every Year.

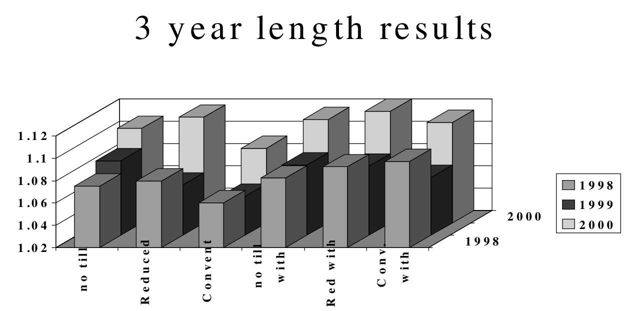

Figure 13: 3 Year Length Results.