

## EFFECT OF DEEP TILLAGE ON ALFALFA YIELD

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Deep tillage (tillage greater than 18 inches in depth) is practiced in many areas of the West to improve crop yields. Changes which may be achieved by deep tillage are increased infiltration rate, fracture of stratified layers, mixing of the soil profile, and reduction in bulk density and soil strength.

Field equipment usually compacts soil to about 12 to 18 inches and this compaction can be removed by frequent shallow tillage. In contrast to shallow tillage, deep tillage effects may last for many years.

Heavy-duty moldboard plow, chisel or slip plow can be used for deep tillage. Deep moldboard plowing is the most expensive of the three methods. The slip plow developed in the Southwest can result in lifting and shattering the soil layers down to 4 to 6 feet deep.

It is difficult to predict the effects of deep tillage because they vary widely. Two important factors which influence the changes achieved by deep tillage are soil moisture at the time of tillage and soil texture. Even if tillage makes an improvement such as reduced soil strength, there will be an effect on crop yield only if that factor was reducing crop yield. For example, shallow rooted crops may show no response to deep tillage but deeper rooted crops can have dramatic increases in yield as a result of deep tillage.

The effect of deep tillage on alfalfa yields has been studied in the Imperial Valley of California and in Bushland, Texas near Amarillo. The work at Brawley was done on light and heavy textured soils while the work in Texas was done on heavy textured soils.

The work in Imperial Valley was done by Dr. Malek Kaddah who worked at the Imperial Valley Conservation Research Center from 1967-1977. During this time, Dr. Kaddah worked to define the effect of tillage for different crops and soil textures. Dr. Kaddah found that deep tillage had a large effect on yield of alfalfa on light textured soils but a lesser effect on a clay soil.

### Study Number 1

This study was conducted in the Imperial Valley on a Rositas fine sandy loam planted to alfalfa (plots 50 by 100 feet) with four replications.

<u>Tillage Treatment</u>	<u>Alfalfa Yield</u> tons/acre
Disking 8" deep	4.6
Slip plowing 36" one direction	7.2
Slip plowing 36" two directions	11.2
Moldboard plowing 36"	9.4
LSD (0.05)	0.9

There were large yield increases in alfalfa yield resulting from deep tillage and this effect was mainly due to reduced soil strength which seemed to result in deeper and more dense root growth. Penetrometer tests showed reduced soil strength for deep tillage treatments in the 1 to 3 feet depths. In the disking treatments roots were mainly restricted to the upper 12 to 16 inches, in contrast slip plowed plots had roots down to 3 to 4 feet.

### Study Number 2

This study was conducted in the Imperial Valley on a Holtville silty clay soil [silty clay (0-18 inches) silty loam (18-40 inches)]. Plots were 20 by 20 feet and treatments were replicated three times.

<u>Tillage Treatment</u>	<u>Alfalfa Yield</u> tons/acre
Disking 8"	7.4
Mixing 24" deep	8.7
Mixing 48" deep	9.3
LSD (0.05)	0.5

Deep tillage affected alfalfa yields less in this clay soil, compared to the sandy loam soil, and the effect seemed to result from reduced soil strength. There were no measured differences in infiltration rate or bulk density. The deep tillage increased penetration of alfalfa roots.

### Study Number 3

This study was conducted in a Pullman clay loam soil at Bushland, Texas.

<u>Tillage Treatment</u> <u>Mixing</u>	<u>Alfalfa Yield</u> tons/acre
	5.8 A
35"	7.2 B
59"	8.1 B

Deep tillage resulted in greater and deeper root growth and this was the reason for most of the yield increase. There were no significant differences in yield between plots where the soil was mixed either 35 or 59 inches. Deep tillage increased the infiltration rate and resulted in a higher availability of moisture because the alfalfa was irrigated only once between cuttings. When alfalfa was irrigated twice between cuttings, the yield increases resulting from deep tillage were less. Yields, water infiltration rates, bulk densities and surface elevations showed that the effects of deep tillage done in 1964 persisted 12 years later.

Additional work should be done to evaluate how long the effects of deep tillage lasts. Also the conditions that result in yield increases from deep tillage should be defined more precisely.

### REFERENCES

- Eck, Harold V., T. Martinez, and G. C. Wilson. 1977. Alfalfa Production on a Profile Modified Slowly Permeable Soil. Soil Sci. Soc. Am. J. 41:1181-1186.
- Kaddah, M. T. 1975. Deep Tillage to Enhance Crop Growth in a Stratified Fine Sandy Soil. Paper 75-1566. Am. Soc. Agr. Eng., St. Joseph, Mich.