Dec 11th, 12:00 AM

Tillage Considerations on Previously Flooded Soils

H. Mark Hanna
Iowa State University, hmhanna@iastate.edu

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H. Mark Hanna, Extension Ag Engineer, Agricultural and Biosystems Engineering, Iowa State University

Introduction

Many Iowa fields had wet or underwater areas during part of the growing season. Many wet areas were planted late which resulted in late-maturing crop. Yields have been variable in these areas, sometimes significantly below that of yields in areas not subject to wet soil conditions.

In these conditions a frequent concern of growers is that excessive rainfall, wet soil, and/or lower crop yield have damaged soil structure and that these damages may warrant significant tillage operations prior to next season's crop to loosen soil and ameliorate damage to soil structure.

Similar concerns after the 1993 crop season prompted a field study with farmer cooperators to compare tillage effects on soil conditions and crop yield during the following 1994 crop season. Although 1993's excessive rainfall events occurred more during mid-season (June-July-August) rather than 2008 (excessive rain during April-May-June), in both cases significant tillage was not able to be done during the growing season in most instances.

Field study

During fall 1993, four farmer cooperators on five different sites in the Henry-Des Moines-Louisa county area in southeast Iowa agreed to establish replicated strips of tillage trials in production corn-soybean fields to be planted in spring 1994 (Table 1). According to rainfall records at nearby weather recording stations, the fields had received 66 – 85% above normal rainfall during the April – October 1993 growing season.

Table 1. County, soil type, and crop of farmer cooperator sites

Site	County	Soil type	Crop
1	Henry	Mahaska/Taintor silty clay loam	Corn
2	Des Moines	Mahaska/Taintor silty clay loam	Corn
3	Henry	Kalona silty clay loam	Soybean
4	Louisa	Mahaska/Otley silty clay loam	Corn
5	Louisa	Mahaska/Otley silty clay loam	Soybean

Each grower compared three tillage management schemes during fall field preparation for the subsequent crop: 1) deep tillage using a subsoiler (ripper) to a depth of approximately 12 in., 2) moderate tillage with a chisel plow or disk operating at a depth of 6 – 7 in., or 3) no fall tillage. During the spring prior to planting both the subsoiled and chiseled or disked ground was field cultivated to level the soil for planting. A field cultivator was also used at a very shallow (2 in.) depth by some of the operators in previously untilled soil areas as they were concerned about their planter's ability to function in an unprepared seedbed. This resulted in a comparison of three tillage treatments ('shallow', 'moderate', and 'deep').

Effects on both soil compaction and crop yield were measured during the 1994 growing season. Soil compaction measurements included soil sampling in April prior to planting (and prior to tillage in the shallow treatment), in mid-June as crop vegetative growth was accelerating, and post-harvest in October.

Results and discussion

Fall tillage after the wet soil conditions did not have a statistically significant effect on the resulting soil bulk density, either as measured during pre-plant conditions in April or post-harvest conditions in October (Figure 1).

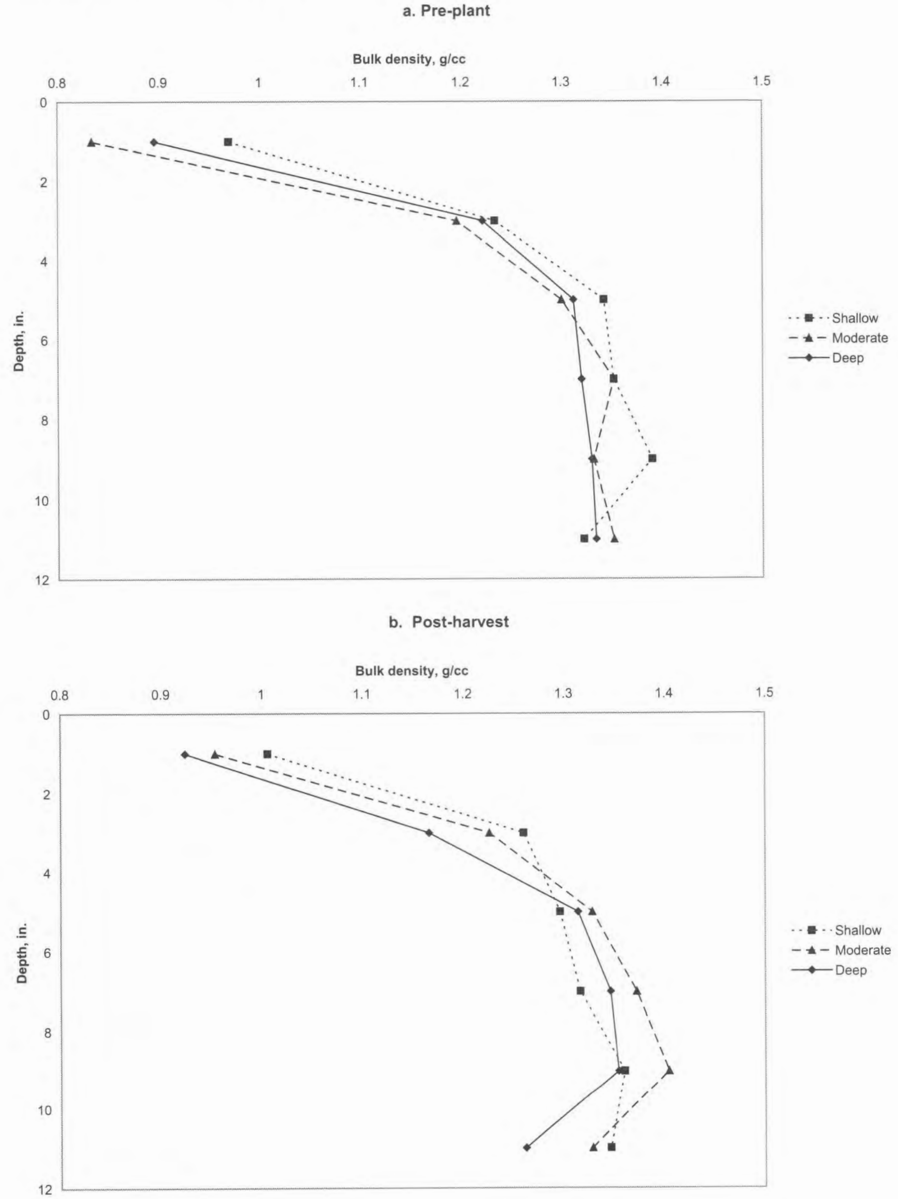

Figure 1. Average pre-plant and post-harvest soil bulk density from field-scale plots receiving shallow, moderate, or deep tillage.

Other natural factors such as over-winter freeze-thaw cycles in the soil prior to the April measurement or effects of shrink cracks propagating as soil moisture was used during the crop season prior to the October measurement may have done as much or more than tillage to loosen the soil.

Penetrometer resistance was, however, statistically less with tillage before planting in April (Figure 2). Just after harvest, penetration resistance for shallow and moderate tillage was similar, but both were greater than that of deep tillage.

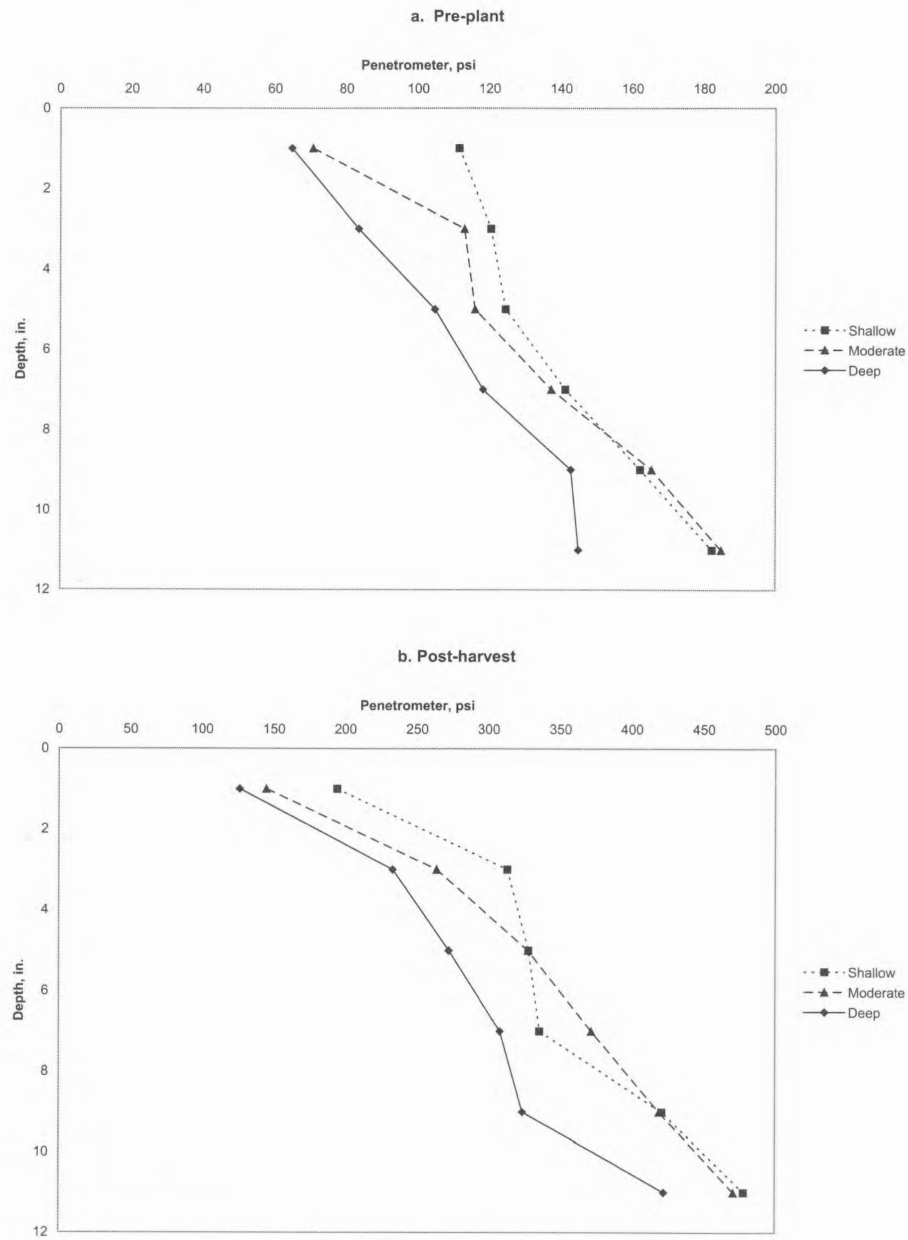

Figure 2. Average pre-plant and post-harvest penetrometer resistance from field-scale plots receiving shallow, moderate, or deep tillage.

A rainfall event during mid-June soil sampling after soil measurements had been taken at two of the sites precluded sampling at other locations as crops were rapidly developing. Data not shown from these post-plant measurements at these two sites agreed with pre-plant and post-harvest measurements. Bulk density was not different among tillage systems and although penetration resistance was less in deep tilled soil, there was no difference in penetration resistance by this time of rapidly developing root systems between shallow and moderate tillage.

Yield was unaffected by tillage (Table 2) in the year after extremely wet or ponded soil conditions. Growing conditions were relatively good despite rainfall during the crop season that was only about 2/3 that of a normal year. Soil conditions were dry at harvest as evidenced by high penetrometer readings (Figure 2b).

Table 2. Average crop yields for shallow, moderate, and deep tillage after 'rain-compacted' soil.

	Yield, bu/acre	
Tillage	**Corn**	**Soybean**
Shallow	204	60
Moderate	193	59
Deep	197	56
Least significant difference	NS[a]	NS

[a]Yields were not statistically different

Although there was some difference in penetrometer readings between tillage systems, crop root growth is typically not inhibited below 300 psi as was measured during April and June. High post-harvest penetrometer readings were likely due to dry soil conditions rather than a sign of late-season rooting difficulty.

Tillage generally had a limited effect in loosening soil. Because yields were equivalent if not higher with reduced tillage, input costs for extra tillage passes decreased the potential for profitability. Current custom rates for subsoiling and chisel plowing are in the range of $15 - $20 and $10 - $15 per acre, respectively. Costs with owned equipment are often similar to custom costs unless equipment is well depreciated.

Results observed in this study may not be unusual. Some growers worry about the weight of standing, ponded water on soil. Although there is a certain amount of pressure associated with increasing depth of standing water, the pressure is hydrostatic and exerted equally in all directions (i.e., both 'up' and 'down') so that soil voids are not compacted by water weight. Caution should always be used when attempting to extrapolate results to different situations (e.g., rainfall patterns during the prior year, different soil and weather growing conditions during the subsequent crop season), but these results suggest being cautious before spending time, fuel, and money tilling to ameliorate poor, wet soil growing conditions from a prior season.

Conclusions

Based on these results following fall primary tillage after a year of excessive rainfall and standing water on silty clay loam textured fields in southeast Iowa:

- As measured by soil bulk density (the mass of soil particles within a given volume) tillage did not physically loosen soil any more than soil that was left untilled.
- Tillage lessened penetration resistance the spring after fall tillage, but the effect did not linger into the growing season unless tillage was deep (~12 in.).
- Crop yield was unaffected the next year by the depth or amount of tillage that was done.

Because there was no increase of crop yield with tillage (in fact a slight decrease), growers should carefully consider the amount of extra yield required to cover tillage costs and whether benefits exist for tilling soil after a season of significant rainfall. Tillage was counter-productive and lowered profit potential in this study.

Reference

Heikens, K.E., D.L. Karlen, D.C. Erbach, H.M. Hanna, and J.H. Jensen. 1999. Tillage effects on previously flooded soils. Journal of Production Agriculture 12(3):409-414.